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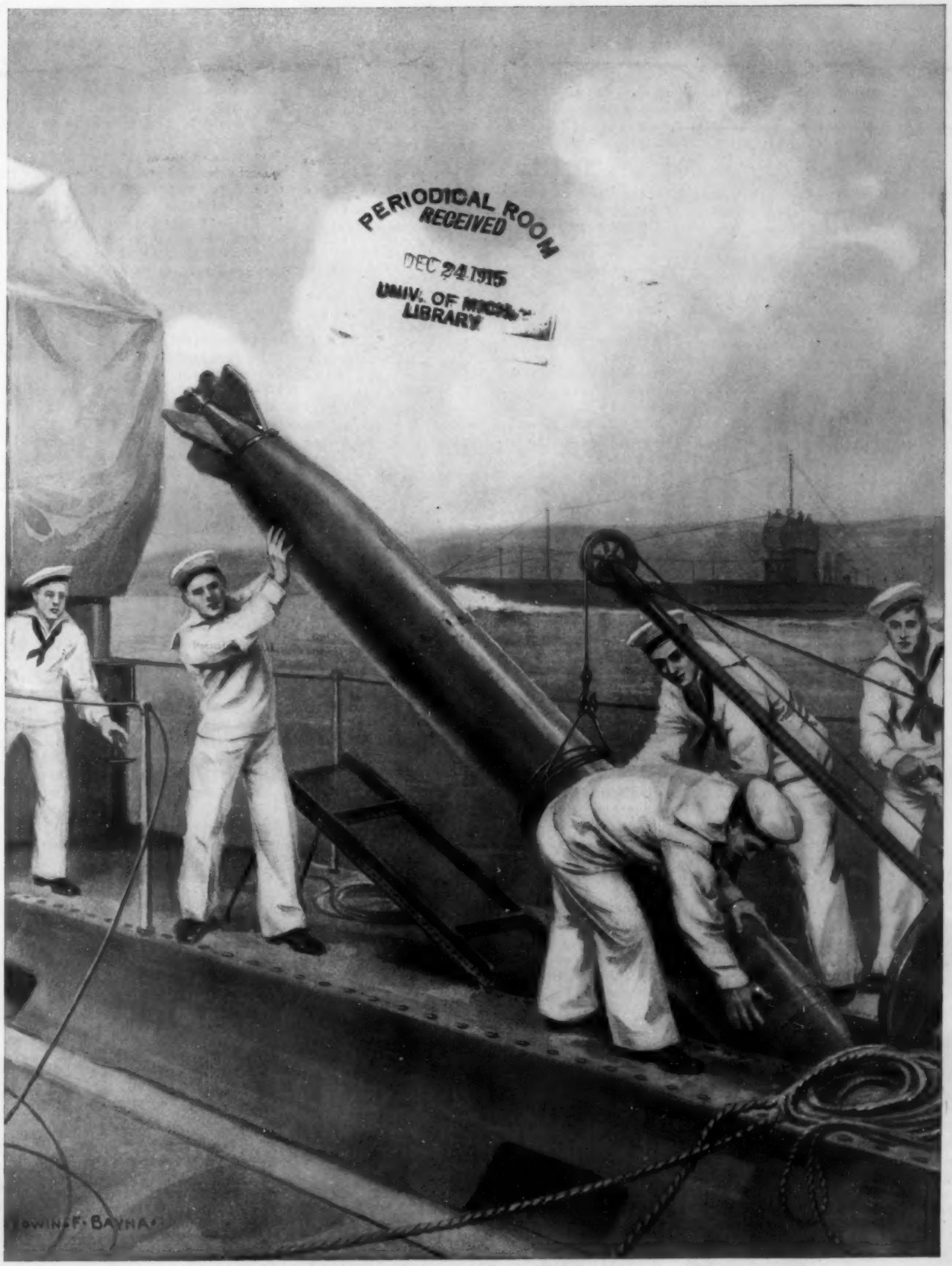

TAKING ABOARD THE PROJECTILES OF A U. S. SUBMARINE

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

A Well Rounded Fleet

DURING all his incumbency of the office of Secretary of the Navy, Mr. Daniels has never sent to Congress a more timely and illuminating communication than his recent report on the lessons of the European war and their effect on naval construction. To those of us who have a more or less intimate knowledge of the interior workings of the Navy Department, this report is particularly gratifying; for it carries internal evidence that, so far as the purely technical work of the Navy is concerned, Mr. Daniels reveals an increasing disposition to accept and pass forward to Congress, with the stamp of his approval, the expert reports, recommendations, etc., of his naval advisers. This is as it should be, and it shows on the part of the Secretary that sincere desire to get at the exact truth through the only body of men who are qualified to give it, which is one of the most desirable, if not indispensable, qualities in the make-up of a successful Secretary of the Navy.

In view of the fact that the United States Navy is to-day passing through a most important crisis, particularly as regards the make-up and strength of its fleet, every communication of the Secretary to Congress is of grave importance and will necessarily be far reaching in its effect—particularly so, when we bear in mind the danger that the technically untrained mind of the average Congressman may cause him to draw absolutely wrong conclusions from the various incidents of the present war in Europe. Therefore, the Secretary is to be congratulated upon the fact that his report establishes the position of the battleship as the foundation and supreme fighting unit of a modern navy, and explodes the oft-repeated fallacy that its place can be taken by any small and relatively cheap naval unit, such as the destroyer, the submarine or the seaplane.

Furthermore, the report shows that, to render the battleship capable of bringing its crushing power to bear upon the enemy, it is necessary that there should be built up around it a well proportioned fleet of lesser units—the battle-cruiser, fast scout, destroyer, submarine and the seaplane—and that if these various types are to realize their full efficiency they must have the highest possible speed, every one of them, consistent with other essential qualities.

In his report, the Secretary responds to a resolution which asks that he advise Congress with regard to "the building of four warships of the type, power and speed which, in the Secretary's judgment, based on a knowledge gained in the prevailing war in Europe, are best suited to war on the sea; also to report in the light of that war the value and uses in naval warfare of aeroplanes, dirigibles, air balloons and submarines."

In reply to this the Secretary says: "The first and most important lesson is that the British Grand Fleet, composed not only of dreadnoughts and superdreadnoughts, but also of battle-cruisers, light cruisers, destroyers, submarines and auxiliaries, has to-day maintained command of the sea, therefore assuring to Great Britain and her Allies communication with all parts of the world and reasonably safe over-sea transport for her military forces and supplies, at the same time denying similar advantages to her adversaries."

The report draws attention to the fact that the First Lord of the Admiralty had stated that by the end of 1915 there would have been added to the fleet fifteen capital ships, together with a corresponding number of vessels of other types. "My reply, therefore," says the Secretary, "to the question as to the single type of warship best suited for war on the sea is that such a vessel must possess, in a maximum degree, all of the four prime requisites mentioned in the Naval Appropriation Act in connection with our battleships, which are required to be vessels 'carrying as heavy armor and as powerful armament as any vessel of their class; to have the highest practicable speed and greatest desirable radius of action.'" The report states that in the dreadnought "California" we have reached the highest practicable limit of size for the United States.

The Secretary refers to the "notable fact that in every naval event of consequence which has occurred in the North Sea area, the leading parts have been taken by vessels of the battle-cruiser and scout types." And he states that, as the result of the war maneuvers carried out recently by our Navy, it is the opinion of the officers engaged in those maneuvers. As to the uses of aeroplanes, dirigibles and balloons, it is believed that all of these types of aircraft have demonstrated their value for observation and scouting and for directing and controlling gunfire.

On the subject of the submarine, it is pointed out that the war found the defense and counter-offensive undeveloped, but with the gaining of experience submarine operations were rendered increasingly hazardout, and that "the strength of the counter-offensive or defense is amply demonstrated by the fact that the strength in modern capital ships of no one of the belligerents has been seriously impaired by the operations or attack of submarines. They have not demonstrated that they possess a preponderant value over other requisite types." Finally, the Secretary, in tracing the battles off Chile and the Falkland Islands, draws attention to the great strategic and practical value of the high-speed, heavily gunned battle-cruiser in stopping the depredations of the armored cruisers "Scharnhorst" and "Gneisenau."

A Flight of Fancy

SO precise is the work of the engineer—so painstakingly exact—that one is apt to overlook the part that is played by imagination in every really great undertaking. Without imagination, progress is impossible. Without a vision in the mind of some man, no monumental work has ever been launched. To be truly great, an engineer must be by nature a visionary, with the ability, however, to curb himself and keep within the bounds of the possible, or rather to distinguish between the practical and the absolutely impracticable.

Nothing gives an imaginative man greater pleasure than to indulge his fancies once in a while and set them free to fly into the realms of pure romance. Such mental recreation gives him as much delight as did the fairy tales of his boyhood.

It was in such a spirit as this that one of the articles in the recent Electrical Number of the SCIENTIFIC AMERICAN was planned. It was to be a number which was not to be burdened with historical records, but would deal with the present and look on into the future. Even beyond what would seem the limit of practicability in the light of present experience.

Some engineering friends of the SCIENTIFIC AMERICAN have been alarmed lest some of the articles be taken too seriously, particularly the one on a proposed development of Niagara Falls. Possibly we were mistaken in assuming that even the layman would recognize this project as a vision rather than a practical proposition. To an engineer a number of very serious objections to the scheme present themselves at the very outset. Particularly is this true of the plan to make use of the power of the falls behind the screen of falling water. An engineer might well stand aghast if he were actually confronted with the task of building such a plant. The shelf of rock over which the Niagara River falls has been undermined to such an extent that, at the level of the pool below, there is a variable distance from the face of the rock to the sheet of falling water of between seventy and eighty-five feet. This distance varies with the volume of water coming over the falls, and the volume varies in accordance with the direction of the wind on Lake Erie. When the wind blows from the west, the water is piled up to such an extent as to be cast farther out. This would make it necessary to move the proposed water wheel bodily outward to the exact point where it would bite into the requisite depth of water and of withdrawing the wheel as the wind changed so as to prevent the water from falling squarely on the wheel and destroying it. The difficulty of moving such a cumbrous hydraulic plant on the instant seems almost insuperable. Furthermore, it would be no small task to provide a platform seventy-five feet out from the face of the rock on which to support the wheel. It may not be generally known that the river is about three hundred feet deep at the foot of the falls, and, instead of acting as a cushion to break the impact of the falling water, it presents actually a downward vertical current, scarcely retarded, which strikes the bottom with an enormous impact and scours out a deep pit. This action serves constantly to undermine the shelf of rock, so that it slants back at a considerable angle and affords absolutely no support for the platform that the wheel would have to rest upon. The idea of guarding against erosion by a layer of concrete at the top of the pool is hardly a practical one; for the principal erosion is taking place far down below the level of the water.

As for the dam across the Niagara River above the rapids, while there are no insuperable engineering difficulties in the way of its construction, it might not be amiss to point out that it would cut off from service fully a hundred million dollars' worth of hydroelectric plants on the Canadian shore which have been built under and are protected by a treaty between our Government and that of Canada. These are but a few of the practical difficulties that lie in the way of a full realization of this romantic drama.

The Home Laboratory

IN these days of magnificent endowments, by means of which every scientific field is so ideally developed and brought to fruition, one is apt to discount the possibilities of the home laboratory. There may be some who are deterred from entering those Elysian fields by the reflection that isolated contributions to science would be lost in the vast output of our splendidly equipped institutions.

When Koch, in 1882, announced his discovery of the tubercle bacillus, the essential cause of tuberculosis, Dr. Edward L. Trudeau was living at Saranac Lake whence he had gone to cure himself of that disease. Saranac Lake was at that time but a settlement of half a dozen guides' huts, 40 miles remote from any railroad, utterly desolate in winter, the temperature frequently 40 below zero. Trudeau secured a copy of Koch's epochal paper; and, being without training, he went to New York for a few lessons in the essential principles of bacteriology. At Saranac Lake then, with only his microscope, without access to books—let alone to great libraries—the water often turned to ice in his house, a wood stove being the only means of warming it, Trudeau devised a thermostat that had no regulating apparatus except that it was made of a number of boxes each inside the other; this incubator was heated only by a small kerosene lamp. His guinea pigs he kept in a hole in the ground, warmed by an oil lamp, this being the only spot in Saranac Lake where they could escape freezing at night. Under these circumstances did Trudeau obtain the tubercle bacillus in pure culture, being the second observer in America to do this; and with these cultures he repeated all of Koch's inoculation experiments. One night, while he was ill, the lamp in his apparatus exploded, burning his house, records, cultures, guinea pigs and all it contained. Upon these ashes a friend built the best equipped laboratory for medical research in America.

Koch himself, at seventeen, persuaded his father to get him a microscope, much as another youth might want a fowling piece or a motor car. Possessed of this most congenial companion he set about perfecting other technical means of investigation. Even genius cannot work effectively without tools. So Koch himself took a hand in the making of just such tools as he needed. After attaining his degree he became a simple country doctor, utilizing his spare time—what young doctor has not all too plenty of this commodity—in scientific research, experimentation and writing. But he did not write until he had something to write about. And then the world had something epochal to read.

The Abbe Mendel, experimenting upon peas in cloister gardens, evolved the most valid theory of heredity at present known to science. The Curies revolutionized the physical sciences by their radium discoveries; and this in most unpretentious laboratories. The clergyman Spellanzane started physicians investigating the process of digestion by making a dog swallow a perforated wooden ball into the hollow of which meat had been introduced, in order to learn whether the function of this organ is by reason of digestive ferments of or through attrition by the gastric muscles.

A New Bridge at New London

OWING to the great increase in the weight of railway equipment in recent years the bridge on the New Haven road over the Thames river, at New London, has been a drawback to the efficient operation of the road, as, although it was originally built as a two-track structure, since 1908 it has been necessary to limit it to single-track operation. It has now been decided to replace this bridge by a new structure of unusually heavy construction that will not only accommodate existing traffic, but will provide for anything contemplated for the old bridge, which was built in 1888-89 at a cost of $1,300,000. It consisted of five spans totaling 1,423 feet, and had a swing draw span of 503 feet. The new bridge will have a four-track substructure, and a two-track superstructure, leaving room for two more tracks that may be added when required. Like the old bridge, the new design calls for five spans, but the total length will be 1,387 feet, with an electrically operated bascule lift. The new bridge is located 185 feet up stream from the old structure, and will have approaches of 1,300 feet on the west side of the river, and 1,600 on the east side, and in leaving out the west approach a re-alinement of track, which has been going on, will permit of a much easier curve.

Aeronautics

Diminutive Gasoline Engine for Cranking Airship Engines.—There has been developed in England a gasoline engine of the twin-cylinder opposed type intended for the starting up of the huge engines now used on seaplanes and airships. The complete auxiliary power plant weighs but 23¼ pounds; the total weight including a magneto weighing over seven pounds and a carbureter tipping the scales at nearly two and one half pounds. The engine develops over four horsepower and operates at speeds exceeding 4,000 revolutions per minute.

Increasing Value of Zeppelins.—Basing his opinion upon certain information contained in a report which he has received from England, Henry A. Wise Wood, President of the Society of Aeronautic Engineers, Vice-President of the Aero Club of America, and a member of Secretary Daniels' Naval Consulting Board, states that the United States must at once enter upon the construction of Zeppelin type airships if it is to have adequate aerial defenses. While he does not divulge the exact nature of the report in question, it is said to be of utmost importance to those interested in aeronautics.

Seaplane Launched from Moving Warship.—Recently, a navy seaplane was successfully launched from the American cruiser "North Carolina" while the latter was under way; the event representing the culmination of a series of experiments which started in 1912. The launching device used is in the form of a car propelled along a track, the aircraft being held on the car until it reaches the end of the track. When the car stops, the seaplane is released and proceeds under its own power through the air. To give the seaplane the necessary momentum, the car is propelled along the track at a gradually increasing speed up to about 50 miles an hour.

Twelve-cylinder Aeroplane Motors.—The success of the twelve-cylinder motor in automobile racing has brought about a new type of aeroplane motor for high-speed, high-power work. The motor, of twelve cylinders set in V-shape at the required angle of 60 deg., delivers 225 horse-power at 3,000 revolutions per minute. One of the peculiarities of this engine is the extraordinary demand it puts on the lubrication system. Not less than 35 pounds per square inch pressure is required to force the oil to the bearings, and as the engine gets very hot, this oil supply must be conducted through 30 feet of 22-gage copper piping of ⅞-inch diameter, in order to be cool enough for lubrication.

Gigantic German Battleplanes in Building.—Baron Cederstrom, director of the Swedish government aeroplane factory at Soederteige, is credited with a brief statement concerning German battleplanes of gigantic proportions which he examined while visiting aviation centers in Germany. The new battleplanes are said to be three times the size of the ordinary Albatross type, with tremendous lifting power, great stability, high speed, and carrying an unprecedented weight of armor, armament, fuel and provisions, together with a large crew. It is further stated that the craft is steered from the bridge, like a steamer.

Zeppelins Use Drop Searchlights.—According to an item in the *Hamburger Fremdenblatt* one of the Zeppelins which raided London recently carried a new sort of searchlight. The reflector and electric bulb were carried suspended from a 1,000-foot insulated wire, so that the blinding light disturbed the aim of the anti-aircraft guns. Shrapnel is reported to have hit the searchlight after several minutes of bombardment and to have put it out of commission, but during the few minutes which it operated it proved its efficiency as a defense against the searchlights from the ground. One of the officers of the Zeppelin reported that in the glare of his searchlight he clearly saw the Woolwich arsenal struck by one of the bombs, followed by a heavy explosion in the plant.

First United States Navy Balloon Nearing Completion.—America's first naval airship is nearing completion at the factory of an aircraft manufacturing plant in Connecticut. According to the final specifications, the airship is to be 175 feet long, its maximum height 50 feet, and its greatest beam 35 feet. Where the fins are attached, the beam is increased to 50 feet. The volume of the envelope is to be 115,000 cubic feet, while each ballonette is to have a capacity of 15,000 cubic feet. The weight of the envelope is to be 15,000 pounds. The dead weight of the machine is specified as 4,000 pounds, while the lifting effort is 7,800 pounds, leaving the carrying capacity in the neighborhood of 3,800 pounds of useful load. The dirigible is to be driven by a 150-horse-power motor through two four-bladed propellers. The maximum speed is specified at between 25 and 35 miles an hour, which can be maintained for a period of five hours. The dirigible is to be capable of rising to a height of 5,000 feet.

Science

The Survey of Cuban Waters, which the United States Navy has had in hand ever since the close of the Spanish-American War, continues to make good progress. This work began with surveys of all the harbors of any consequence in the island. The geographical positions of these places were next established telegraphically by a special expedition. At present a detailed survey of the entire south coast is under way. During the coming winter operations will extend westward from Casilda toward the Isle of Pines. Two Cuban gunboats assisted the American surveyors last winter, and will continue their collaboration.

An Institution for the Study of Anthropoid Apes.—Prof. R. M. Yerkes, of Harvard University, has outlined a plan for establishing in southern California an institution devoted to the study of the behavior, psychology and social relations of man's nearest relatives among the brutes; viz, the anthropoid apes. The only institution of the kind now in existence appears to be one conducted by Germans in the Canary Islands. Prof. Yerkes proposes to provide quarters for sexually mature orang utans, chimpanzees and gibbons during a three-year test of the possibility of breeding in the suggested location, which would be a more favorable one for scientific research than one within the tropics. At the same time adolescent apes and monkeys would be studied by the station staff. Ultimately "the most diverse aspects of the lives of the Anthropoidea (including man) might be studied."

The Atmosphere of the Soil.—Recent investigations made in England by Messrs. E. J. Russell and A. Appleyard on the composition of the free air found in the pores of the soil are reported in the *Journal of Agricultural Science*. Samples of air down to a depth of six inches were taken with the apparatus devised by Hall and Russell, consisting of a hollow cylindrical steel tube fitted with a cylindrical ramrod and connected with a mercury reservoir. The soil was a heavy loam, with many stones. While very similar in composition to atmospheric air, the soil air was found to contain more carbon dioxide and correspondingly less oxygen (average, by volume, 0.25 per cent CO_2 and 20.6 O, as compared with 0.03 CO_2 and 20.96 O in the atmosphere), and to be subject to greater fluctuations in composition. These fluctuations are chiefly due to fluctuations in the rate of biochemical change in the soil, and seem to be independent of weather conditions, such as barometric pressure, wind velocity, variations of temperature from the normal, deficient rainfall, etc.

An Unfortunate Conflict of Dates.—Dr. L. O. Howard, permanent secretary of the American Association, calls attention in *Science* to the fact that "the committee designated to take charge of the Second Pan-American Scientific Congress to be held in Washington, without consultation with officers of the American Association for the Advancement of Science or, apparently, with other well-posted scientific men in this country, changed the date of the Congress from October, 1915, to December 27th, 1915-January 8th, 1916"—a period which includes the whole of the time when the American Association, together with its numerous affiliated scientific societies, will be meeting in Columbus! The dates of both meetings had been irrevocably fixed before this unfortunate conflict was discovered. The only consoling feature of the situation is that, as the Congress will be in session a week longer than the American Association, members of the latter will be able to attend the latter half of the Pan-American gathering. Plans are now on foot to have the association hold a special session in Washington after adjourning at Columbus.

Date Culture in the United States.—The Department of Agriculture states in a recent publication that the date palm, which a few years ago was merely a botanical curiosity in this country, "is now the basis of one of the great prospective fruit industries of the southwest. Offshoots of practically every important Old World date variety have been imported, and there is now in the date gardens of this country a larger collection of date varieties than can be found in any one oasis of the Old World." Progress in the American industry includes the development of a method for the identification of varieties by their leaf characteristics, and means of ripening the fruit artificially in unfavorable seasons. Importations of varieties have been made from Egypt, Algeria, Tunis, Morocco, Nubia and the oases of the Great Sahara, both by expeditions sent out especially for the purpose and through correspondents in date-growing countries. At present the department is devoting much attention to the problem of developing a rational system of fertilizing the soil for date culture. It has recently been found that in alkali soils, which bake and thereby reduce the yield of this fruit, the addition of numerous small quantities of calcium sulphate keeps the soil in good condition and improves the crop in both quantity and quality.

Inventions

Rubber Comb with Staggered Teeth.—A new idea in the construction of the rubber comb, makes the implement much more serviceable and at the same time more desirable for the use of those persons who have thick or curly hair. The teeth in this comb are set in staggered formation projecting alternately on either side, and at the base of each tooth there is an opening in the form of a large loop, thus cutting down the amount of friction as the comb passes through the hair.

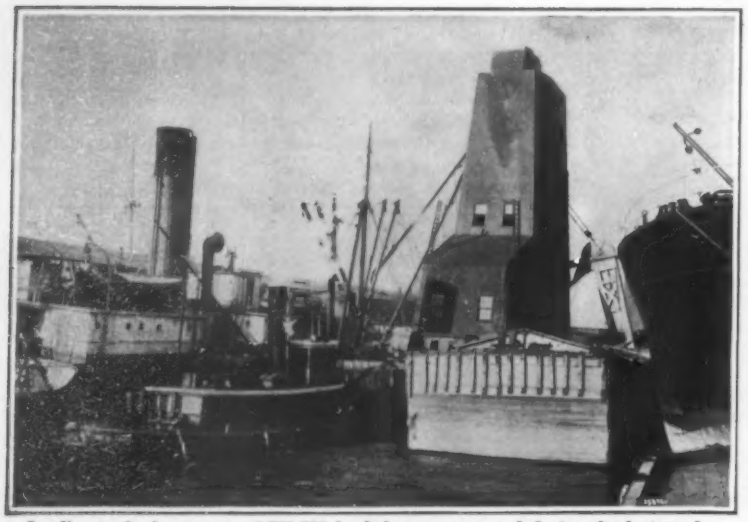
Combination Bed and Swinging Seat.—The open air advocate who happens to be without the luxury of an open air bedroom may make use of his porch as such without unduly littering the front by the presence of a bed or cot, by utilizing a combination bed and swinging seat which has been recently granted a patent. As a swinging seat the article is all that could be desired in its utility and its appearance, and when it is desired to make use of it as a bed, the back is lowered and the front foot rest is raised. In this position the three parts are substantially on the same level, and the addition of some bed clothing makes a very comfortable and roomy bed.

A New Radiator Valve has the convenience of being operated by a single movement of a handle by the foot and also that it requires no packing. Many who have had experiences with radiators will appreciate the value of these innovations, for the familiar valve with the wheel-shaped handle has a well-known tendency to stick under the corroding action of moisture and the contraction and expansion of changing temperature. In the new valve a small lever handle is eccentrically mounted on a brass stem and by swinging this handle over one way or the other, as may be done by the foot, the passage is either closed or opened. The packing is dispensed with by the use of a hard rubber ring at the base of the stem, which it is said expands when the heat is on, making a tight joint and cutting off the working parts from contact with the heat.

Two-Collar System of Harnessing.—A New York inventor has recently secured a patent on a new "two-collar" system of harnessing a pair of horses, in which it is claimed that the best features of the Dutch or breast collar and the hame collar are combined, with the result that the weight of the load being drawn is distributed over the breast and shoulders of the animals. In order to accommodate the breast strap, it has been necessary to make some radical changes in the form of the hame collar, the latter being in the general form of a triangle, the hames forming two sides with a long connecting link between the two lower ends of the hames forming the third side of the triangle. This makes an opening at the bottom between the front and lower part of the collar and the chest of the animal where the usual breast strap passes around in front of the horse.

New Tree Insulator.—Some of the electrical companies have recently adopted a new tree insulator which it is thought will prevent much damage to the foliage along the lines, and at the same time overcome unpleasant incidents with the property owners relative to the alleged injury to trees by the presence of the current-carrying wires through their branches. The desired protection is secured by the use of a split metal sleeve which is galvanized, to protect it from the action of the weather, and which is made in different lengths to meet the varying demands. This is slipped on the wire and clamped in place at the point of contact. Inside, at either end of the tube, are split porcelain bushings which serve both to insulate and to center the wire in the sleeve. The use of this device involves a small expenditure and prevents the injurious rubbing and the escape of the current through the tree, which is desirable both from the standpoint of the property owner and the electric company.

Sashless Window Pane for Railway Cars.—The last vestige of wood entering into the design of the modern passenger coach has disappeared in the utilization of the sashless window frame which is being introduced on some of the leading lines. The innovation is being viewed with curiosity and interest by the riders, for its novelty is bound to attract attention. The sash is dispensed with entirely and its place is taken by a piece of plate glass covering the entire window opening. The glass is held rather firmly in place between two strips on each side of heavy felt, between which it is moved with a slight effort, but the adhesion of the felt and glass surface is sufficient to hold the pane at any point that the passenger may desire. The movement of the glass is facilitated by two knobs secured to the pane near the top, which also serve the purpose of preventing the glass from dropping below the sill when lowered to its fullest extent for the admission of air. The upper edge of the glass is protected by a narrow edging of metal. The opening being at the top and over the heads of the occupants of the car, there is no unpleasant blast of air.



Loading grain for export. 2,770,733 bushels were exported during the last week of November

Congestion of shipping in New York harbor Barges and canal boats with cargoes for ocean vessels

The Freight Congestion at the Port of New York

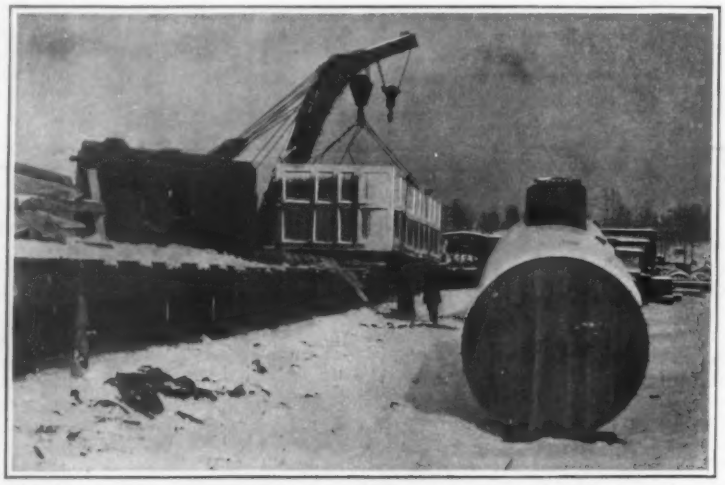
Object Lesson Emphasizing Our Urgent Need of a Merchant Marine

By Herbert T. Wade

DURING the months of November and December there has been experienced on the eastern seaboard and especially at the port of New York and on the railways entering the various terminals about the harbor a serious condition of freight congestion to an extent never before realized. At the middle of December it was reported that some 45,000 cars, over twice the amount of the car shortage for the entire United States, were tied up in the vicinity of New York city, and that there was ready for export at New York Harbor five times as much freight as the available vessels could take. Grain elevators were filled to capacity, piers and docks were piled high with merchandise, and thousands of cars were used as warehouses at a time when there was a general shortage of cars throughout the United States.

This congestion of freight cars laden with commodities designed both for foreign shipment and for home consumption, in the freight terminals in and about New York city, as well as along the rail approaches to the metropolis, involves a situation full of broad significance and possesses far more than local interest. Indeed, the matter has an international bearing in that much of the freight designed for foreign shipment, estimated on December 1st at 700,000 tons, and increasing, consisted of war munitions, food stuffs and other supplies for the fighting nations, which could not be forwarded promptly on account of the difficulty in obtaining tonnage on freight steamers. The Allies are bending every effort to supply suitable tonnage, and usually their American agents see that the ships are available as the goods are received by rail and are properly placed so as to receive freight of military importance on the pier or by lighter as soon as discharged from the freight cars.

In addition, there is a national question of no small commercial importance, for this congestion of freight prevents not only the movement of material from interior points to seaboard, but, by producing a shortage of cars and curtailing distribution, it tends to cripple the normal commerce of the country, which after a period of depression is now increasing to a most satisfactory degree. Any shortage of freight cars at this time is a matter of widespread and serious national interest. In 1906 and 1907, millions of bushels of wheat rotted in the fields of the west on account of lack of cars to take them to seaboard, and the farmers in these sections were said in many cases to have had to burn fences and barns for fuel because the railroads could not bring them coal.



Loading a 30-ton case on a freight car. Part of a large shipment of locomotives for Vladivostock, held up by the closing of the Panama Canal. The locomotive parts have been lying along the tracks at Greenville, N. J., for many weeks

Of course it is very easy to assign reasons or causes for the congestion of freight at New York and other eastern ports. Naturally there has been a dearth of foreign ships owned by the Allies and neutral nations which are available to the allied governments, not to mention American exporters, whose trade not only to Europe but to South America, Asia and Africa has grown by leaps and bounds. Failing steamships, even sailing vessels have been in demand. The slides on the Panama Canal early in October interfered with the shipment of a vast amount of material to Vladivostock and other far eastern ports, routed through the canal. Furthermore, the Greek government ordered an embargo and requisitioned all Greek steamers which were in New York loading, or on the way to New York, to take cargo to the Far East and Europe.

The exports to Europe, it must be understood, have not been exclusively war material. Grain cargoes have been large and frequent, and there has been a demand in excess of the supply of steamers for grain, as well as for coal, timber and general cargo.

Much of the congestion of freight has been due to permitting shippers to use cars for storage pending delivery to an elevator or other transfer point, or to vessels, or customers. If there is a lack of demand for cars, or, conversely, a considerable surplus, the number of idle cars loaded on sidings is not considered a serious matter, so that under all circumstances the shipper is wont to think it his privilege to use the cars for storage until he is ready to have his freight delivered. When, however, a surplus of cars changes to a shortage, then idle rolling stock means loss of revenue, and the congestion of traffic on terminals or junction points

Typical freight terminal in New York. Elevators filled with grain and unable to receive contents of cars

A vast sea of freight cars, waiting for delivery of their contents, by lighter, to cargo ships

involves a serious dislocation of the orderly operation of the lines.

With their New York freight yards and sidings filled with cars they could not dispose of, the railways adopted the heroic measure of declaring embargoes or refusing to accept freight. Thus the Lackawanna applied its embargo to all shipments free on board at New York for re-shipment abroad, because on its line between Scranton and New York, when the order was issued, there were not less than 6,000 cars loaded with export freight, as compared with less than 2,000 cars which would have been between these points under normal conditions. Later in the month it was announced that embargoes had been declared on flour and timber for export under through bills of lading by the New York Central, the Erie, the Central Railroad of New Jersey, the Lackawanna, the Lehigh Valley and the Pennsylvania.

The embargoes at first declared were followed by additional embargoes made by the Lehigh Valley and the Central of New Jersey, the former placing an embargo on export, domestic and coastwise shipments of hay and straw; export, domestic and coastwise shipments of wire of all kinds, nails of all kinds, iron and steel rails; export and domestic carload shipments of locomotives and parts thereof, machinery, and all iron and steel articles. The Central of New Jersey placed an embargo on all export traffic, also on hay and straw, and on locomotives and parts thereof consigned to all New York deliveries.

The necessity for such an embargo can be seen from an outline of the situation on the various divisions of the Pennsylvania Railroad east of Pittsburgh and Erie as it existed on November 30th. In New York there were on hand 6,151 cars of freight for export and lighterage to New York. In addition to the lighterage freight held in cars there had been unloaded on piers in New York some 2,000 carloads of freight which was awaiting orders. There were on various divisions of the railroad at the time stated, exclusive of cars of freight for lighterage, some 7,000 cars of slow freight for delivery or movement through the New York terminal district. There were also present, stored at different points of the railroad, 450 cars of flour and 125 cars of lumber under through bills of lading for export through the port of New York.

The congestion was not confined to New York. The Pennsylvania also found it necessary to place embargoes at the ports of Philadelphia and Baltimore on export grain. In addition to the 1,000,000 bushels of grain in the new and spacious Girard Point elevator at Philadelphia on the evening of November 28th, there were 1,778 cars, 2,600,000 bushels of export grain on hand to go through the elevator. Of these cars 453 were standing in the Girard Point district, and the others

(Concluded on page 564)

Progress of the Seagoing Flying Boat

By Baron Ladislas D'Orcy

A FURTHER step has just been accomplished in the development of the marine aeroplane.

There is building, in the aircraft yards of the Curtiss Aeroplane Company at Buffalo, a huge flying boat, whose size and power exceed any craft aloft.

This machine, which can properly be called the first battleship aeroplane, is a direct development of the "America," a twin-engine flying boat which was to cross the Atlantic in the summer of 1914, when the outbreak of the war stopped the attempt.

At the time the "America" evoked much admiration and also much criticism, for she embodied several features which were a radical departure from previous practice. Prominent among these was the disposition of the propelling apparatus, which consisted of two 90 h.p. water-cooled V-type engines, each driving a pusher air-screw and mounted on either side of the longitudinal axis between the supporting planes.

Although considerable difficulty was experienced at first in making this flying boat get off the water, a proper adjustment of the hydroplaning surfaces of the hull soon vindicated the hopes of her builders and enabled the craft to make extended flights over Lake Keuka. The magnitude of this engineering enterprise is best illustrated by the total weight of the "America" (2,600 lbs.) when fully equipped, whereas the aeroplanes of her time were limited to carrying about 1,500 lbs. only; and while the latter had a maximum useful load of 650 lbs., the "America" carried about 1,100 lbs.

Built for purposes of peace, the "America" was soon to play an important rôle in the great war. In November, 1914, the boat was purchased by the British Admiralty and put in commission with a coast defense aeroplane squadron. Her usefulness became soon evident in connection with the troop transports which were plying the English Channel; for, owing to her greater carrying power, and consequently cruising radius, the "America" was particularly fit for acting as a scout against submarines. How successful this American-made flying boat was in the task allotted to her can be judged from the fact that she has destroyed three German submarines, while none of the latter has ever been able to attack successfully a British transport in the Channel.

The British Admiralty quickly grasped the importance of this wonderful fighting instrument, and soon an order for twelve, then one for twenty, flying boats of the "America" class was placed with her builders.

It is beyond question that these machines have played a very notable, if not preponderant, part in Great Britain's anti-submarine campaign, first checking, then (as their number was increased) almost completely paralyzing Germany's undersea boats, wherever they were pitted against the vigilance of the eye-from-above.

For, possessed of a speed three times that of the swiftest submarine, and of a deep sea vision which a submarine is unable to prevent, the seagoing flying boat can hunt down the former to either capture or destruction—be it by means of her own bombs or else by leaving this task to the mosquito fleet of 40-knot speed boats. Finally, two or three flying boats generally suffice to drive a submarine (when half-submerged) into a prearranged wire netting, where she will stick fast.

Aircraft construction, however, develops along the very lines of evolution which have been, and still are, the law for vessels of war, and which can be summarized in one word: *bigger!*

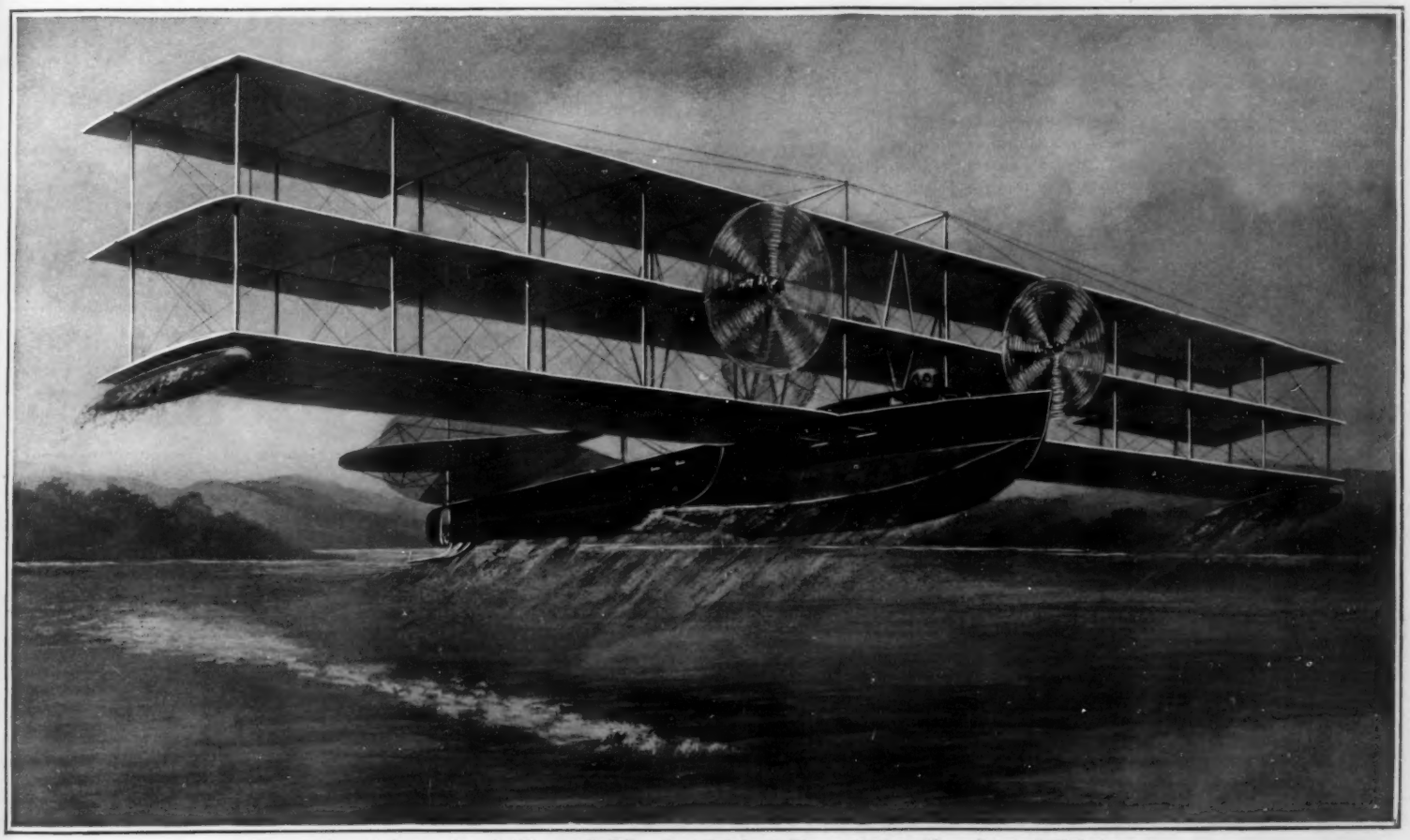
For an aeroplane that carries more men at a greater speed, more bombs, larger guns and more fuel, is obviously more powerful and less apt to suffer from an attack by the enemy. Furthermore, and this is an all-important feature, as the aeroplane's size increases, its stability increases with its inertia; therefore a wind puff that might impair the stability of an ordinary aeroplane will have little or no effect on a modern battleship-aeroplane, if the latter carries adequate surface and power.

The "battleship-aeroplane" that is building at the yards of the Curtiss Company is a triple-screw triplane flying boat, which will weigh, fully equipped, 21,450 lbs.

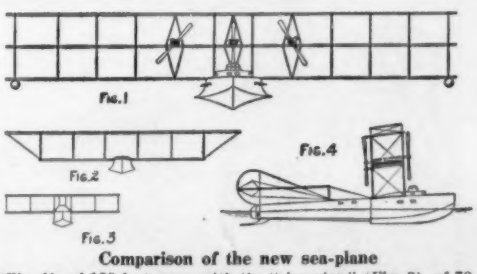
The hull is of cedar planking, sheathed with copper on the under side and riveted to stout ash ribs; it is 68 feet long and has a beam of 20 feet. The hydroplaning surface of the hull is furnished with a V-shaped bottom, which ends in a straight stem forward, while its rear, cut off sharply, gives the "step," on which the boat must ride in order to get off the sea. From the step on the hull it has straight side lines and tapers gently towards the stern, to end with a water-rudder.

The hull is divided into twelve water-tight compart-

(Concluded on page 565)



Huge military hydroaeroplane building at Buffalo. Span 133 feet. Planes 10 feet wide and spaced 10 feet apart



Comparison of the new sea-plane

(Fig. 1), of 133-foot span, with the "America" (Fig. 2), of 72-foot span, and the standard hydroaeroplane (Fig 3), of 35-foot span. Fig 4 is a side view of the new machine.

Strategic Moves of the War, December 16th, 1915

By Our Military Expert

WHILE there have been no actual movements of importance taking place on the Russian battle line within the last few weeks, the possibility of Roumanian introduction into the great war, permitting the launching of Russian forces into the Balkan theatre of war, and the approach of winter, when the ground will be frozen hard enough to favor offensive movements, may safely form the basis of assumption that the section in question should be much before the public eye ere long.

Attention has been so generally drawn to the triumphant march of the Teutonic legions through Serbia that recollections of the Russian situation have probably faded somewhat in contrast. It may be well, therefore, to outline the scope of the existing Russian front in anticipation of eventualities.

Beginning in the vicinity of Riga, in the north, the hostile lines of intrenchments front one another from the southern shore of Lake Kanger across the expanse of land to Lake Babil, squatting squarely across the railway from Riga to Libau. Directly in rear of this line the River Aa turns northeast at Shlock and follows the shore line of the Gulf of Riga to a point near the city from which the gulf takes its name. Situated on the River Dvina, near the gulf, its possession by the Germans, with its docking facilities and railways, would prove extremely valuable as a base for further operations of moment. While tremendous efforts have been made to take the sector, the Russians have not only held on, but have extended their lines somewhat since the drive against them commenced.

From the extremity of Lake Babil the contending lines of trenches sweep southward and southeast in a wide curve east of the River Aa, covering the important railroad from Mitau, which city lies in German hands, to Riga.

From the Mitau-Riga railway the line runs approximately eastward to Friedrichstadt, undulating a trifle before the railway line to Dvinsk, an important junction in rear of the Russian front. The position proceeds through Jacobstadt, through the lake region west of Dvinsk to Novo Alexandrovsk and southward to Gateny, again through a lake region to Vidsy and on to Baranovitschi, another important junction, whose secure possession is rather debatable—and the line wavers about to the Pinsk marshes, where it is interrupted by unfavorable ground.

Below the marsh region the Russians hold the west bank of the River Styr, where there has been intermittent fighting for some time without material result. Budka, near Lutsk, is in the Russian lines, which cross the Styr and proceed through Chartosk, Kolki, Dubno, Butchatch, Zalerkishuk, to the vicinity of Chernowitz near the borders of Russia, Roumania and Bessarabia.

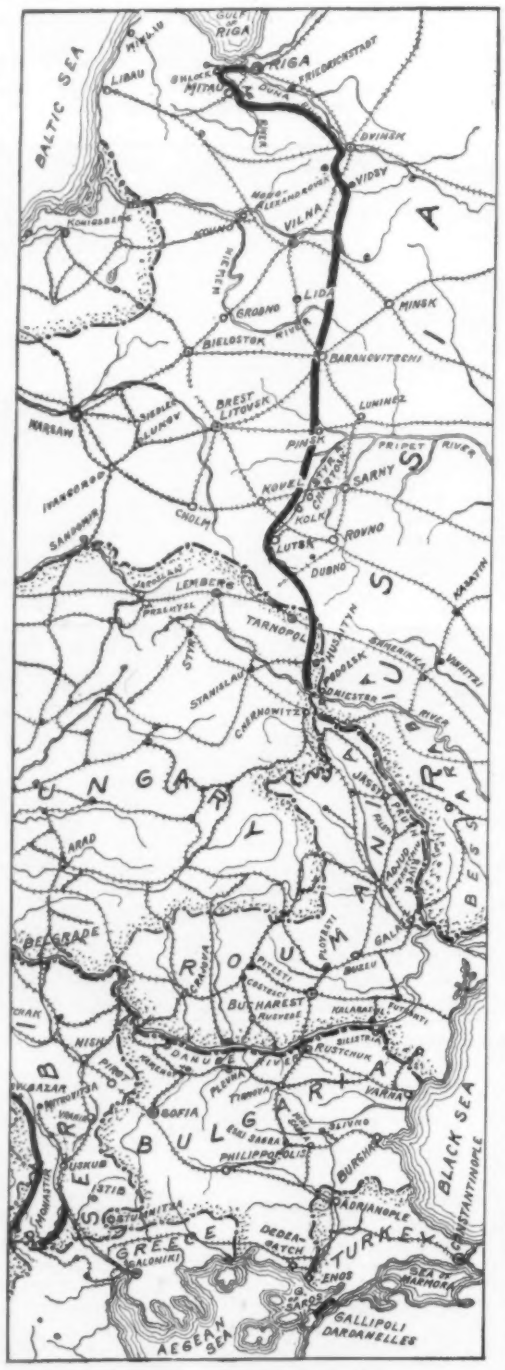
In October there occurred much fighting about Dvinsk. October and November witnessed a terrific German hammering towards Riga, while combats spluttered along the Styr. On the lower part of the line there have been a number of minor actions, but the most favorable railways east of Lemberg appear to be in the possession of the Russians, which accrues to their advantage in Galicia.

The position of the eastern battle-front, in fact, is practically that of a few weeks since, with some minor changes which scarcely affect the general situation.

Effort has been made by countless analyses to solve the riddle of the comparative inaction on the main western and eastern lines. One estimate of the situation has it that the Teutonic forces have made all the gains they actually desire at present; that they have extended their lines until they rest in such position that the resumption of the offensive in the spring will be expedited; and that they are content to go into winter intrenchments occupied merely by strong holding forces, releasing thereby first-line troops for the Balkan campaign. This seems reasonable; yet there is another side of the question from which to view the situation.

It is certain that the German-Austrian forces which are taking part in the Balkan campaign came from the Russian line. Is it unreasonable to assume that their forces were thereby so depleted that further offensive measures could not be successfully undertaken? For the Balkan campaign became necessary to supplement the diplomacy striving to secure the active assistance of Balkan states and preserve the neutrality of others. It was necessary to impress these wavering countries with a display of force and the driving home of a successful campaign. Incidentally, the delayed punishment of Serbia would demonstrate an impressive sweep of the mailed fist.

To gain time for Russia to re-gird her loins for a general assault, and for the arms, ammunition, men and equipments to be secured for a fresh development of strength, it became—and still remains—of paramount necessity that Germany should not be permitted to muster strength against Russia for major operations on the offensive. The principal problem, then, which confronts the Entente allies is to see that these Germanic forces now held in the Balkans cannot return to the main line. For this reason the belief that not only will Saloniki be held, but heavily reinforced, as is reported from abroad, is expressed; though prophecy, even founded upon precept, is so uncertain, so exposed to overthrow in this era of warfare of a magnitude hitherto unknown, that it is undertaken necessarily with diffidence and humility.



Map of the eastern fighting front

Continuing: if, then, the German forces do not care to attack, it should not be the policy of their enemy to permit them to have their wish if sufficient force can be arrayed against them to establish a real threat. According to reports, Russia is rapidly recovering from her late reverses. Munitions are flowing in through Archangel, now soon to be closed by a wall of sea-ice, and along the Trans-Siberian line. From the hordes of peasantry which form the bulk of Russia's gigantic population, men, young and hardy, are being gathered to the colors, if reports be true. In the abstract, it is acknowledged that when first-line troops are withdrawn to initiate an offensive or stem a tide of attack in another quarter, less effective troops must supply the vacancies created on the line, whether the relieving forces consist of troops schooled in war to a lesser extent than their predecessors, or of troops composed principally of older men—reserves, Landwehr, if you will—who are perfectly able to hold a line of trenches when reasonably comfortable winter quarters have been provided for them against the ravages of the bitter elements of the season. But if these same more elderly men, less hardy physically than their younger comrades, less able to endure hardship, are forced to emerge into the open, to take their chances without the aid of reasonable shelter from the elements, a long campaign against at least equal numbers of younger men, should accrue to the latter, all other things being equal.

Every angle of probable benefit or menace is considered by the various general staffs. It is safe to say that this aspect of the situation has been threshed over thoroughly. It remains to be seen whether it will constitute a link in the chain of events which must be forged within a short time.

There is little likelihood of an immediate move on the part of Russia, even if she is ready. The condition of the ground precludes such a possibility, for in countries which are mostly roadless, or wherein such roads as exist are mere streaks in a wilderness, it is impossible to transport the enormous trains of supply and ammunition, to say nothing of the vital artillery and its laden caissons, through depths of sticky Mud, with a capital M.

This condition of "gumminess," to which many authorities attribute the fall of Bonaparte at Waterloo, will cease to exist with the advent of freezing weather. With the ground frozen solid, the surface of marshes, lakes and rivers likewise, geographical difficulties which constituted strong factors of defense in more temperate seasons, become liable to turning movements and offer no obstacle save lack of cover to an uninterrupted advance or a cohesive assault.

These reasons, coupled with the alleged regeneration of Russian strength, lead to the belief by many that the next two months will witness great activity on the eastern line.

There is little doubt that Russia has concentrated strong forces in Bessarabia and near the Roumanian border, and only awaits Roumania's decision before beginning an advance through her territory, either friendly or hostile as the balance of decision swings for or against the Entente cause.

At the risk of unnecessary repetition, it is deemed worth while to stress the importance the Saloniki position bears in relation to the battle array on all fronts. The attitude of Greece toward what troops, if any, she will permit to pursue the retreating Entente forces across her borders should be solved before these lines are printed. The hostility, nay, hatred, existing between Greek and Bulgar may play an important part, for if only German and Austrian troops shall be given this permission, tacit or otherwise, the investment of the Saloniki lines will require a large Teutonic force, which will, of course, not be available for use elsewhere. With Roumania teetering to a decision, the Bulgars must fear to detach any considerable strength from within easy access to the homeland.

The same prohibition which forbids the abandonment of Greece by the Entente, that of holding large bodies of enemy troops from other fields, discards the suggestion that the Gallipoli forces be shunted to Greece. Their removal from the peninsula would release Turkish forces for utilization in other campaigns. Such forces, therefore, as may be despatched to strengthen the Entente allies in Greece must come from the various home countries and, according to seemingly authentic reports, the decision to send them promptly appears to have been reached.

The general situation resembles a monster pot of water beneath which the flame has temporarily slackened. It is seething; and as soon as sufficient fuel is provided it will boil over fiercely. But on which side of the pot the first bubbling-up will occur no one can say, for the heat is equally intense everywhere.

Dust-Suppressing Device

A SOMEWHAT curious method is proposed for suppressing the dust raised on roads by automobiles, at least to a considerable extent. According to a recent European patent, the exhaust gas from the car motor is sent along suitable piping so as to be brought under each wheel at a point near the ground. It is claimed that the escaping gas acts to prevent the partial vacuum of the suction which takes place by the rotation of the wheel, that is, on the side where the wheel rises, and as this is a main factor in making a dust, the new method suppresses the cause and hence is effectual. A variation of the above is to use compressed air for the same purpose.

Explanation of the Double Report of Gunfire

By Leigh F. J. Zerbee, 2nd Lieut., C. A. C., U. S. A.

[The following article is of special interest when compared with the letter of Mr. Hiram Percy Maxim, published in the SCIENTIFIC AMERICAN *of September 18th last. Although Mr. Maxim approached the subject from a widely different angle he reached the same conclusions as did Lieut. Zerbee. In justice to Lieut. Zerbee, we wish to explain that the present article was received in March, 1914, long before Mr. Maxim's letter was written, but was mislaid and has only just come to light.*—ED.]

IN the target practice of both the Coast Artillery Corps and the Navy, the chronological coincidence of the splash and report of the gun has often been remarked by the tug personnel. It has also been remarked that in towing for mortars the report is chronologically before the splash. Furthermore, for guns sometimes two reports are heard, and sometimes only one. As the explanation of these seemingly conflicting phenomena is often asked, the following is offered.

It is commonly known that sound as perceived by the ear is caused by the impinging on the ear drum of a sufficiently rapid vibration of the atmosphere. The pitch of any sound is higher as the rapidity of vibration is greater and the magnitude of a sound varies with the extent of air set in motion. There are many atmospheric vibrations that are not known as sound because their rapidity is either too small or too great to be perceived by the human ear. It is the former case with which we have to deal. Any operation which gives rise to an atmospheric vibration of sufficient rapidity is a primary cause of sound. The velocity of sound in air is about 1,100 feet per second.

Now the ogive of a projectile moving through the air sends off a wave which closely resembles the wave sent off by the bow of a swiftly moving motor boat. The magnitude of the wave varies with the caliber of the projectiles, and its frequency with the velocity of the projectile. Therefore, if we have a projectile of large caliber moving at a slightly greater speed than sound we hear a large "boom" of low pitch; and if we have a small projectile moving at high speed, we have a sharp "crack." The second report so often spoken of is the report of the gun itself. The chronological coincidence of the first report with the splash is due to the close proximity of the tug personnel to the point of impact, and the consequently short distance which the sound wave has to travel. The delayed report of the gun is due to the low velocity of sound and the high velocity of projectiles. At long ranges the remaining velocity of gun projectiles falls below that of sound and only one report is heard, that of the gun. At the range where the average velocity of the projectile equals that of sound only one report would be heard, the two reports coinciding. This, however, is impossible because at such a remaining velocity the wave sent off by the projectile would not be a sound wave.

In towing for mortars only one report is heard, that of the mortar. This is due to the low velocity of mortar projectiles. It always precedes the splash by several seconds as it travels in a direct line from the mortar to the tug and at a higher velocity than the average velocity of the projectile.

The Current Supplement

THE current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2086, for December 25th, 1915, completes the volume and contains the *Index* for the past six months, making this issue indispensable to every reader. *The Problem of the Crippled Soldier* deals with an important economic question that faces Europe, and one that will in all probability more or less affect the whole world. The article is written by a well-known efficiency expert who has had an opportunity of studying the problem on the ground, and will be of universal interest. *Some Protective Activities of Organisms* tells of a number of methods by which nature affords protection to its weaker creations, and there are a number of illustrations accompanying the description. *Commercial Conditions in South America* gives some valuable facts in regard to how matters are conducted on the west coast of that continent, that are timely in connection with the suggestions looking toward closer business relations in that direction. *The Leuk-Leukerbad Railway* gives a short description of an electric railway recently opened in Switzerland leading through a beautiful section of the Valasian Alps; and there are a number of exceptionally attractive pictures. *Economy in Food* tells of wartime measures that are interesting Europe, and it contains some suggestions from which this country might profit. *Heat Transmission* discusses problems of increasing importance. *A High Efficiency Induction Coil* gives full instructions for building an induction coil of novel design from which unusual results can be secured. It is well worthy of the attention of everyone interested in electrical experiments. There are also interesting articles on *A Modern Psychology of Animals*, *Metastability of Metals*, *War Telephones* and *Welding and Cutting Metals* with gas torches.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Foresight of Henry Ford

To the Editor of the SCIENTIFIC AMERICAN:

A few days since, a man who has been connected with the motor car business for a long time remarked to me that he believed the remarkable success of the Ford Company, and the great popularity of the car, was due more to Mr. Ford's luck in just blindly following up a line that proved to be the right one, rather than to any foresight regarding the popular type of car, or the large proportions that the business has attained.

Having, many times before, heard similar remarks, I have concluded to offer some of my experiences and conversations with Mr. Ford in the early days. In order to do this, it will be necessary to give a slight history of myself and my connection with the subject.

With two partners, I opened a garage and salesroom at 640 Main St., Cincinnati, January 1st, 1902. We were agents for the Searchmont, made in Philadelphia, but this car was a little expensive for our trade and we were looking out for a small car to sell in connection.

In 1903, a man, who was representing an oil company came into our office, and during the conversation, stated that there was a new car being brought out called the "Fordmobile" in which he was greatly interested because of his acquaintance with Mr. Ford, and upon looking through his grip he found a little catalogue which he gave to me.

Shortly after, I went to Detroit and tried out the "Northern," a single cylinder similar to the "Oldsmobile" of that period, and afterward called at the Ford factory on Mack Ave., which was little more than a shed. Mr. Ford was busy in the shop and Jas. Couzins was practically the whole office.

I made a deal for our territory with Mr. Couzins and purchased a model "A" Ford. This was a double opposed motor 4 x 4 placed longitudinally in the body. After numerous improvements in the Models F and C, the announcement was made, I believe, late in 1905 that Ford would build a four-cylinder car that would sell for $500, and that the new model would be shown at the coming New York show.

It is difficult to imagine at this time the excitement this announcement caused in automobile circles, and among the people who were getting the craze. Such a thing was not thought possible and Mr. Ford was accused of deliberately lying for advertising purposes. The Ford Company, however, kept very quiet regarding the car, only informing the public that the car would be shown as stated.

I arrived at the show on the opening morning and immediately looked up the Ford booth, but to my great disappointment there was nothing on exhibition excepting the old models and I guess I was not the only disappointed one. The car, Model N, arrived the next day and I had the pleasure of helping lift it up, while a platform elevated sufficiently for the crowd to see it was placed. It was difficult for anyone to get close enough to examine it while the show lasted.

We, like hundreds of others placed an order for a sample. Deliveries, however, were delayed until late the next summer, and, finally, in desperation I went to Detroit accompanied by Mr. Tom Scott, a young mechanic. I told Mr. Ford that I had come to stay until I got our sample and that we proposed to drive it to Cincinnati, and after two or three days, they were so tired of seeing us around the factory that they finally gave us our car.

The engine was so stiff that we were compelled to hitch it behind an old Model B, and drag it around with the clutch engaged until we got it running under its own power.

Mr. Ford learned that we expected to leave after luncheon for Cincinnati, in spite of their protests that we would "never make it." He and Mrs. Ford with their little boy, who is now secretary of the great company, came down to see the start.

We loaded up with extra oil and started the motor. Mr. Ford called me aside and quietly told me that, owing to the deep sand the entire distance, it was doubtful whether we could get out of the state of Michigan and advised us to go by night boat to Toledo, where we would find good roads south. We refused to take his advice, however, as we had stated that we would drive it through, so amid the cheers of the crowd we started. We made Toledo without serious trouble and spent the night, continuing our journey the next day through rain which stopped us several times, and we arrived in Cincinnati on the second day well covered with mud and oil.

We created considerable excitement on this, the first overland trip of the four-cylinder Ford. I have clippings from papers describing this trip. Owing to the necessity of equipping the car with 3-inch tires in place of 2½-inch, the price was advanced to $550 and other improvements later caused the price to be advanced to $600. But our first cars sold at $500.

As nearly as I can remember it was late in the summer of 1906 that, with several others, I was in Mr. Pelltier's office talking of the future of the business and most of us were very much discouraged as we were making no money and could not see what the future might hold.

Mr. Ford was trying to impress us with his ideas and called our attention to a lady who was at an open window across the narrow street running a sewing machine. He turned to me and asked whether or not I knew the cost of a modern sewing machine and when I pleaded ignorance, he stated that it was less than $9. He also asked at what price, with ordinary machine shop tools, I could build such a machine.

I told him that it would in all probability cost a hundred dollars and he agreed, and added that it would not be as perfect a machine as the lady was using and which cost less than $9. He continued his illustration by describing the methods of manufacturing the parts rapidly on automatic machines, which formed all pieces exactly alike, the hardening and finishing process being uniform in every particular, producing component parts that were positively interchangeable so that any part that had been broken or become worn could be secured and placed in position by most any person. This conversation was leading up to the statement which follows and which should settle the question of Mr. Ford's certainty regarding the future.

"You gentlemen," said Mr. Ford, "have been accustomed to the slow, tedious cut and fit method that we have been using in our manufacture of automobiles. This method will not do, the costly automobile will not do. The success of this company depends upon our producing a car that is cheap enough for the salaried man to buy; light enough in weight so that the cost of the upkeep, tires, etc., would not be prohibitive; so simple in construction that the average man could keep it in repair, so perfect and uniform in its components that these parts would be on sale in all hardware stores and could be purchased at as low a comparative price as the parts for the lady's sewing machine. We do not want to cater to the rich man, we should drop the large car (they had marketed two of the larger type, a four-cylinder Model B in 1905 and a six-cylinder 50 horsepower in 1906 or 1907), we will perfect Model T, design special machinery to produce it at a lower price than any other car on the market and stick to the one model. *It is my whole ambition* to build a car that anyone can afford to own, and to build more of them than any other factory in the world."

E. C. SHUMARD,
Eng. U. S. Motor Truck Co.

Cincinnati, O.

Not an Austrian but a Dutch Submarine

To the Editor of the SCIENTIFIC AMERICAN:

Perhaps it will interest you to know that the article in the SCIENTIFIC AMERICAN, September 18th, 1915, page 250, about Austrian submarines, is not quite correct.

The three illustrations are the interior of a *Netherland's* submarine.

If you doubt my statement, be so kind as to look for the words "vul tank" (filling tank), about 2 inches from the right under corner in photo 1.

WM. VAN HAERSOLTE.
Naval Lieutenant.

The Hague, Holland.

Care of Horses' Hoofs

To the Editor of the SCIENTIFIC AMERICAN:

I am answering Mr. Walter Winan's letter in the Correspondence of the SCIENTIFIC AMERICAN, October 16th, 1915.

I have used melted beef tallow on my horses' hoofs for some years to keep from shoeing them. This, when applied warm once a week, is very effective in preventing ordinary road wear. In cases of extreme wear from rocks and frozen ground, the best remedy I have found is to turn the horse loose until his hoofs renew themselves. A month of rest is generally enough.

I hold that iron shoes hurt a horse from the ground up; and, as my best horses have never had an iron shoe on their hoofs and are strong and clean limbed after 15 years of hard use while other younger horses under my observation, horses that have worn shoes almost continually, are all stove up, my theory seems to have some weight.

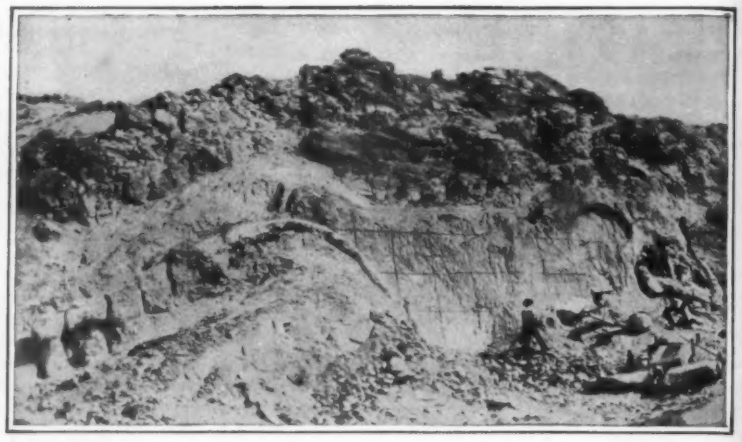
I pick a horse with a dark hoof, as that hoof is generally tougher than the white.

Mr. E. E. Townsend of Ft. Stockton, Texas, a man who has ridden and raised horses for years, agrees with me in this theory. He says the best cushion one can furnish a horse is his natural hoof.

WALDO WILLIAMS.

Ft. Stockton, Texas.

Scene in the newly created Dinosaur National Monument Utah Tract, built in the fossil quarry



Utah's wonderful fossil quarry showing the bones of the monster Brontosaurus imbedded in the solid rock

A Government Fossil Tract in Utah

By Arthur Chapman

PRESIDENT WILSON recently issued a proclamation setting aside as a national monument a wonderful fossil tract in Utah. The new park will be known as Dinosaur National Monument, from the great numbers of skeletons of dinosaurs and other prehistoric reptiles located within its borders. These fossil deposits are declared by scientists to be the most numerous and valuable in the world. It is felt by President Wilson and Secretary Lane that these deposits should not be lost to science by haphazard and unauthorized excavations carried on by vandals or mere speculators, but should be protected until this Government has in its own National Museum a full representation of the principal and most extraordinary types.

Prof. Earl B. Douglass, of the Carnegie Museum at Pittsburgh, is credited with the discovery of this most remarkable fossil field in the world. Prof. Douglass, with a large force of men, has been uncovering its fossil remains since 1909. It is estimated that Carnegie Museum has expended from $25,000 to $50,000 in this tract. Among the prizes which have been discovered here is the skeleton of the largest brontosaurus known to science. It has been necessary to lay railroad tracks to the quarry where the bones are being removed. With the enthusiasm of the true scientist, Prof. Douglass has moved to the scene of his labors, where he and his family live in a little cabin. Prof. Douglass estimates that he has just made a beginning, and that it will take many more years of work to come to the end of the vast fossil deposits which are located in this one spot.

The Dinosaur National Monument is located 15 miles northeast of Vernal, Utah, in the Uinta Basin. Residents in the vicinity of these deposits had made many discoveries of fossil bones. These were plowed up in fields, or picked up by prospectors. Prof. Douglass secured a permit from the Secretary of the Interior to make explorations and excavations, for he was convinced that this region would soon yield great riches to science. He did not find the exact location of the present quarry without much trouble. Considerable exploration work was done without much success until one day Prof. Douglass came across a bone, protruding from the ground and bleached with age. He set to work to unearth this bone, and as he dug found another bone, and yet another, all joined together. Work was started at once, and after months of digging and quarrying, the perfect skeleton of a dinosaur, complete even to the tip of the tail, was uncovered. It was the first time the tail of a dinosaur had ever been found complete. Recently Prof. Douglass discovered a complete skull—a great rarity.

Work on this site has reached gigantic proportions. A great quarry has been gradually developed. As fast as the bones are uncovered, if there is danger of their being broken off, they are covered with plaster of paris. As one walks over the floor of the quarry he steps on little mounds of plaster of paris, covering the ends of protruding bones which will be dug out later on. Every foot of the great quarry has been surveyed and platted, and Prof. Douglass has prepared a chart, showing where every bone is located. The workmen are all skilled men, and use the greatest care. The rock is chiseled carefully away from the bones a thin layer at a time. The work is often very difficult because sometimes the bones will be found jumbled together, surrounded by a hard casing of sandstone. Each bone is painted brown, as it rests in the stone, so that it cannot by any possibility be mistaken by a workman for rock. The loss of a single bone will often destroy the scientific value of an entire skeleton.

Prof. Douglass' great achievement was the uncovering of the largest brontosaurus known to science—the "Brontosaurus Louise," as it has been christened in honor of Mrs. Andrew Carnegie. Two years were consumed in removing the bones of this one monster from the rock. It was necessary to transport the bones 50 miles by wagon before they could be shipped by rail. It was necessary to build a railroad track to the quarry in order to get the pieces to the wagons. The bones of the brontosaurus were found undisturbed. A deep cut was made in the solid rock at the side of the remains, and the stone was quarried away in blocks until the complete skeleton was outlined in the face of the quarry. As it lay exposed in the face of the quarry, the skeleton of this monster measured 85 feet in length and 16½ feet in height. Probably it weighed in life fully 20 tons. Compared with such an animal the largest elephant would be as a dog to a horse.

According to the theory advanced by most scientists who have visited this wonderful spot, many dinosaurs and other prehistoric animals must have floated down some ancient river, from a source unknown, and become imbedded in a sandbar. There they lay for countless years until they were covered to a great depth in the sand. Then came a seismic upheaval which forced the sand bed among the mountain tops.

There are many other places in Utah, Colorado and Wyoming where fossils have been found in great numbers, but this quarry in Utah, where the bones of countless animals have been uncovered, and where evidently many more treasures are still to be found, is regarded as being worthy of preservation by the United States Government. Probably some arrangement will be made with scientists who take up work in the Dinosaur National Monument in the future whereby a certain proportion of their discoveries at least will revert to the Government.

A Newly Discovered Story of the Garden of Eden

SOME years ago among the ruins of Nineveh there was found a cylindrical stone seal engraved with the figures of a man, a woman and a serpent gathered about a tree. At once it was suggested that the ancient Babylonians were familiar with the old Semitic story of Adam and Eve in the Garden of Eden, or the story of the Fall of Man. Also among the ruins of Nineveh was discovered a large collection of clay tablets, a hundred thousand in number, inscribed with the literature of the Babylonians and Assyrians. When the tablets were read, the world was surprised to find among them the story of the Creation of the World, and also a story of the Deluge so similar to the biblical story that it was evident the Hebrew and Assyrian stories were the same.

For several years an expedition from the University of Pennsylvania carried on excavations in the Babylonian city of Nippur, where something like 70,000 inscribed objects were discovered. Many of the inscriptions were brought to Philadelphia. In the autumn of 1912 Prof. Stephen Langdon, an American of Oxford, England, while visiting the museum of the University of Pennsylvania, noticed a fragment of a tablet bearing an inscription which suggested the story of the Garden of Eden. The fragment was carried to Oxford and carefully examined, and at last a few lines of a Babylonian story resembling the biblical story were discovered. Upon Prof. Langdon's next visit to Philadelphia search was made for other fragments of the tablet. Two were found and fitted together, and the tablet became nearly complete. The tablet is of baked clay, of a light brownish color, measuring 7½ inches in length and 5 in width. One side is flat; the other is slightly convex. Upon each side are three columns of cuneiform writing, containing about 273 lines; originally it contained about 300 lines. Scholars are agreed that it comes from about 1,000 years before the biblical story was written in its present shape.

The story is written in the Sumerian language. The Sumerians were the first cultured people to live in the lower Mesopotamian valley to the north of the Persian

(Concluded on page 564)

Story written in Sumerian characters upon a baked clay tablet

The reverse side of the same; one side is flat, the other slightly convex

Christmas in the Air

By Carl Dienstbach

IN spite of all the wonders of true human flight by the heavier-than-air machine, the mammoth dirigible (so far represented only by the rigid Zeppelin and Schuette-Lanz systems), will always hold its spell over those who really know its charms. We speak to-day of floating hotels, and an ocean trip embellished by every conceivable luxury is a rare pleasure indeed, but few as yet seem to realize that we may now speak of soaring hotels with equal correctness.

With the advent of passenger Zeppelins, the progress of science has actually provided an instrument of pleasure which might make us pity all previous generations. In the air there is an incomparably better chance to amalgamate the charms of travel with anything yet produced in the line of superlative domestic luxury than on water or on rails. There is no vibration, jerking, rocking, gale, smell nor smoke, let alone soot and cinders, for the passenger quarters on board a Zeppelin are, according to the writer's experience, as secluded and protected as the chambers of a royal palace. All these qualities go to make the Zeppelin salon ideal in a social sense, the only drawback being the insufficient size of the passenger accommodations on board the big airships. If more room were available, surely a piano would be more appropriate in a Zeppelin salon than on a vibrating, rocking, noisy steamer. No virtuoso could wish for a more pleasant drawing room. An artist would find the Zeppelin salon as satisfactory a studio as his own home and, unlike the accommodations offered by most means of transportation, he would not have to wait until his return home to paint his subjects. The possibilities of a Zeppelin as a banquet hall are so wonderful and so obvious that they alone seem to have been already completely exploited. By comparison the dusty, shaky pullman seems within the realm of barbarism and the stuffy, foul-smelling, rocking steamer salon hardly better. On ordinary trips only cold cuts and champagne are served to the Zeppelin travelers, but on special occasions the menus have been fairly complete. For cooking the food electrically, it is only necessary to take on board the required pots and other culinary utensils. Right here it might be added that electricity also serves to illuminate the airship, operate the long-distance wireless apparatus, and for heating.

An occasion serving to illustrate the completeness of passenger Zeppelins was the dinner given by Dr. Gans to a party of guests on New Year's Eve, 1914, above the city of Frankfurt, on the "Victoria Louise." There were, in the course of the evening, speeches and recitations; but music, including the vocal, violin, 'cello, harp and other varieties, would have been entirely feasible if the guests present possessed the necessary talent.

In the accompanying illustration there is shown another celebration aboard an airship, in this instance the "Hansa," which may be appropriately referred to as Christmas in the air. The Christmas tree, with all its flimsy tinsel and decorations, stands on the cabin table with the same security as it would in any home, although it may be said to be on the edge of an abyss some thousands of feet deep. The beauty of the cabin is obvious. The writer, having been shown through it by Captain Hacker in 1912, when the airship was new, may betray the fact that the shipshape pillars—contrary to those on board a steamer these serve to suspend the light flooring to the upper works and not for supporting the ceiling—are covered with the same fine red leather in which the cabinet is finished.

When the beauties of the continually-changing landscapes that pass below the airship are recalled, together with the comforts offered by a Zeppelin or other huge air cruiser, one begins to appreciate what is in store for the air travelers of the future.

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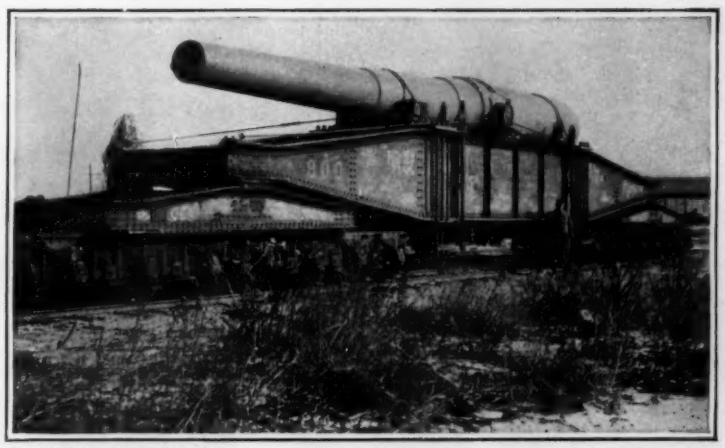
Christmas celebration on board a Zeppelin



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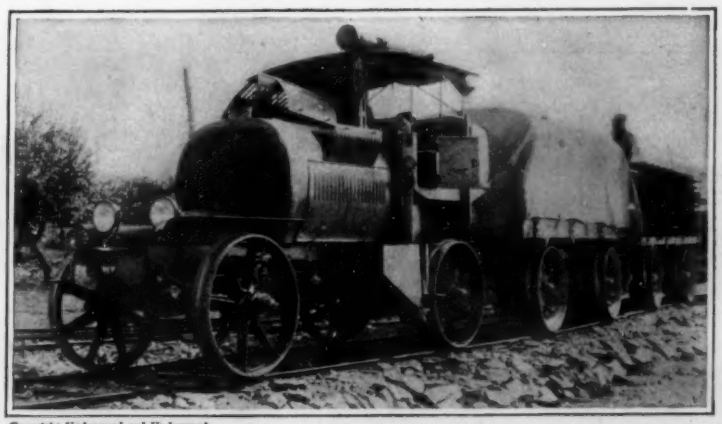
Weight of Gun, 285,500 pounds. *Weight of Shell*, 2,400 pounds. *Initial Velocity*, 2,250 feet per second. *Extreme Range*, 18,500 yards

The army 16-inch gun for the fortifications at the Panama Canal



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Combination railway and road tractor used by the Austrians in the Carso district

Benzine Tractor for Railway and Road Service

THE peculiar requirements of the transportation systems of the European armies has resulted in the introduction of many new and novel forms of engines especially adapted to the conditions under which they must operate.

It would be difficult to find a better example of how the exigencies of military transportation have been met than that of the Austrian benzine tractor which is shown in the accompanying illustration. This machine, which is being employed in the Carso district, in the broader sense may be considered a modified motor truck in that the engine hood, radiator, head-lights, driver's accommodations and other details are conventional, although the truck does not mount a body for carrying passengers or cargo, the machine being strictly a tractor. It is sufficiently powerful to haul a number of cars loaded with military supplies at a fair rate of speed, and it is said to more than compete with the steam locomotive in regions where fuel oils are plentiful and inexpensive.

The real feature of interest presented in the Austrian benzine locomotive, however, is the design of the wheels of both the tractor and its trailers. These are of the broad type so common in road locomotives and agricultural vehicles, and are provided with a center flange which serves to hold the rolling stock on the rails yet permits of successful employment over ordinary highways. Thus the scope of such a train is greatly increased, since it is not limited to use on railroads, which may be said to be conspicuous by their absence in more than one region where fighting is now in progress.

Sixteen-Inch Coast Defense Gun for Panama

CONSIDERABLE confusion exists in the public mind regarding the 16-inch gun, and the impression seems to have been formed that there are several of these powerful pieces in existence in the United States. As a matter of fact, two only have been built: one for the Army and one for the Navy. The Army gun, as shown in the accompanying illustration, is the largest of several types from 8-inch to 16-inch, which were designed some 20 years ago for the coast defenses of the United States. This piece was built at Watervliet arsenal, shipped to Sandy Hook, tested there some ten years ago, and since that time has remained at the Sandy Hook Proving Ground upon the temporary carriage which was used in the firing tests. Recently, the gun was shipped to Watervliet for some slight changes, and it is now at Sandy Hook, where it will be mounted upon a Buffington-Crozier disappearing carriage, after which it will be sent to Panama and form part of the defenses at the Canal entrances.

Judged by modern standards, the gun is of a rather old pattern; for like most of the guns designed at that early date, it is 35 calibres in length; that is to say the bore of the gun is 35 times 16 inches in length. The naval 16-inch gun is an experimental piece, which was built at the Washington Gun Shop and recently underwent very successful tests at the Indian Head Proving Ground. This gun is 45 calibres in length and is a much more powerful piece, its muzzle velocity being 2,600 feet per second as against 2,300 feet per second for the Army gun, the respective muzzle energy of the two guns being something over 100,000 foot-tons for the Navy gun and about 85,000 foot-tons for the Army gun, the latter firing the heavier shell of the two.

In our illustration, the army gun is shown upon a special steel car, which was built for conveying it by rail. It will be noted that the gun is carried upon two heavy longitudinal girders, which are pivoted at each end upon a pair of eight-wheel trucks, the whole load being thus distributed upon 32 wheels.

The weight of the gun is 285,500 pounds. The shell weighing 2,400 pounds, is propelled by 666½ pounds of powder, and it leaves the muzzle with an initial velocity of 2,250 feet per second. Its disappearing mount is so constructed as to permit of a maximum elevation of 15 deg., at which the extreme range of the gun is 18,500 yards.

If the mounting permitted the gun to be elevated to 45 deg., the extreme range would be double that figure, or about 21 miles—that is to say, that if the gun were set up at the Battery, New York, and fired at this elevation, the shell would land at Hastings-on-Hudson.

Some of the World's Largest and Most Notable Bridges

AMONG the engineering and architectural works of man, the bridge is one of the oldest, the ruins of Egypt and even of Mesopotamia revealing the use of this form of structure in the earliest recorded times. In all likelihood, the most primitive bridge was the tree or log thrown across a stream, and it is not unlikely that when stone came into use as a building material, bridges of moderate span were formed by the use of long slabs of this material resting upon opposite banks or upon crude stone abutments. The stone or timber lintel of a door-way, indeed, is a bridge construction of this simple type.

The earliest indications of the arch bridge have been found in Egypt and the Euphrates valley, where the inclinations of two straight slabs meeting at the top, as discovered in recent explorations, shows an early, if crude, form of arch construction. Judging from such remains as have come down to us, the Romans, those master engineers, must have had a thorough knowledge of the principles of arch construction, and they have left some noble evidences of their skill, both in the arch bridge and the dome, the materials in both

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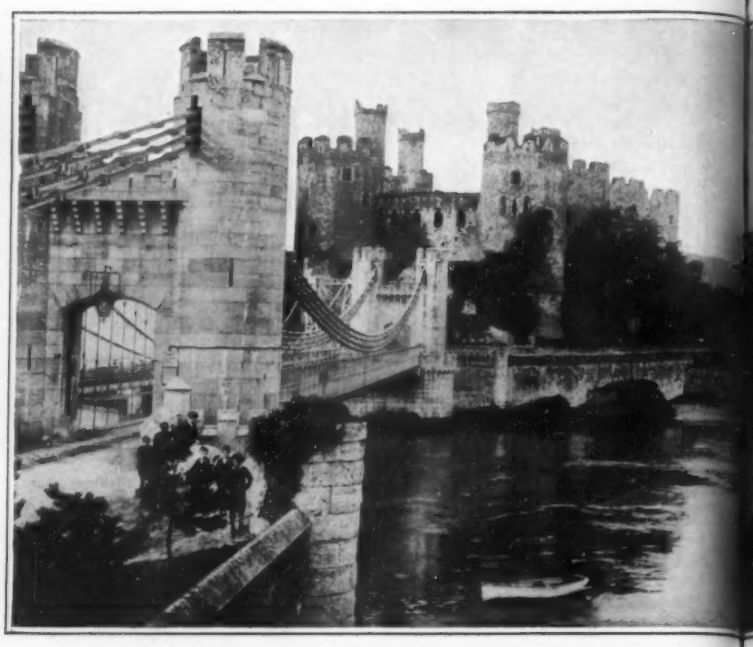
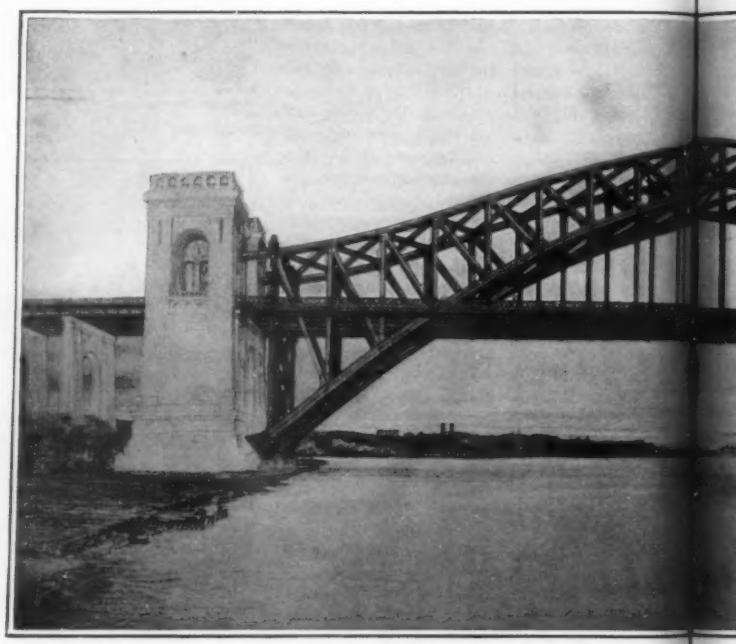
The famous Hawkesbury railway bridge, Sydney, Australia



Conway chain bridge, designed to conform to the architecture of the old castle

Superb marble arch bridge, near Pekin, China



Hellgate steel arch bridge, New York in ex

Steel arch bridge over the Zambezi, highest in the world

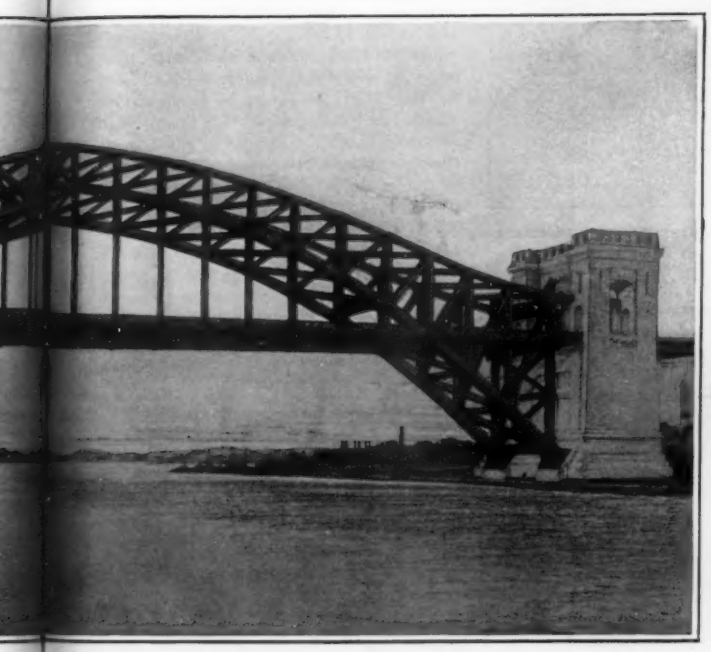
Ancient stone arch near Ventimiglia, Italy

Primitive rope br river,

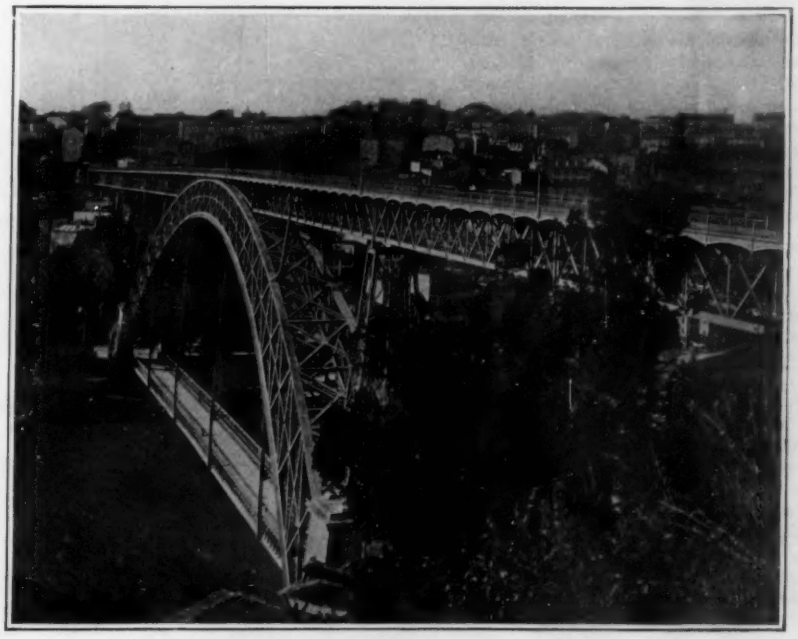
Some of the World's Largest

Chain-link suspension bridge, Clifton, England

Forth bridge, Scotland. Largest cantilever bridge. Each span is 1,710 feet long

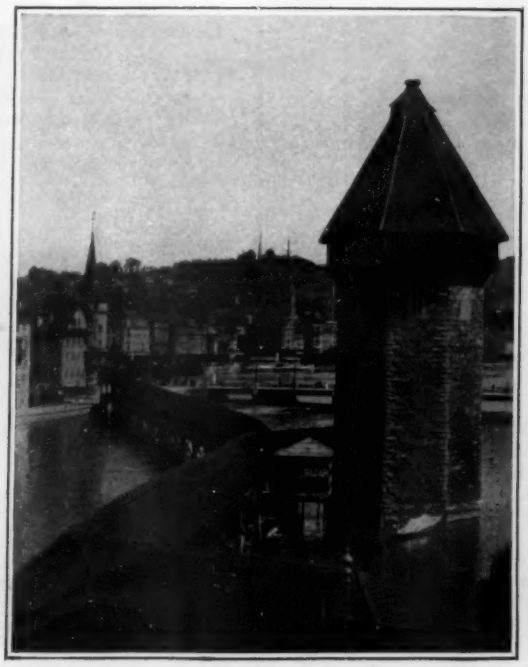


w York in existence. Span 1,000 feet

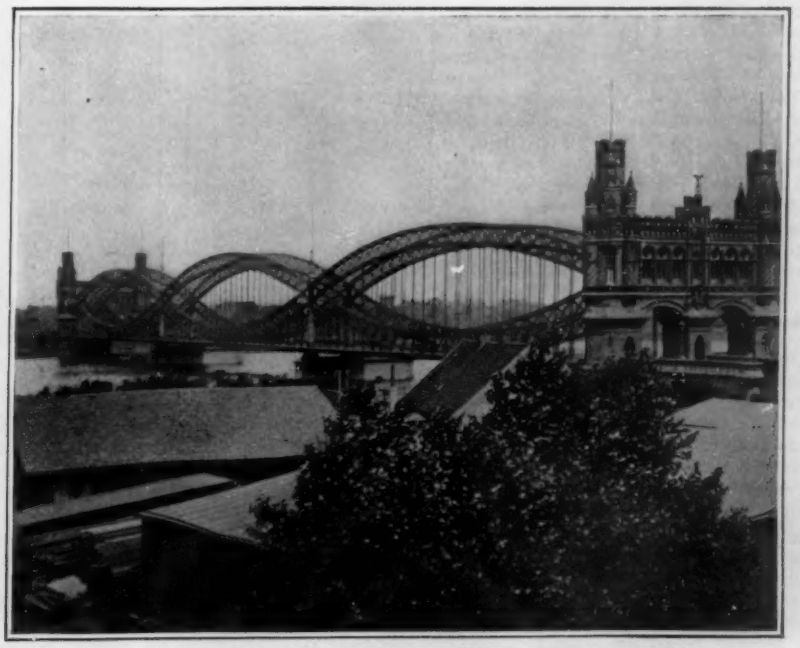


Steel arch bridge over Douro River, Oporto, Portugal

river, India



Ancient wooden bridge 600 years old, Lucerne, Switzerland



Double bowstring bridge over the Elbe at Hamburg

...nd Most Notable Bridges

Inventions New and Interesting

Simple Patent Law; Patent Office News; Notes on Trademarks

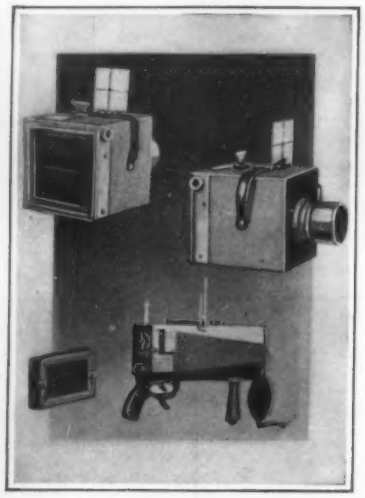
New Sanitary Drinking Tank for U. S. Army

MAJOR T. C. LYSTER, of the Medical Corps of the U. S. Army, has invented a canvas drinking tank for the use of the regular Army, the receptacle of which is constructed along absolutely sanitary lines. The new tank has been thoroughly tested by the Army field hospitals which were recently encamped at Tobyhanna, Pa., and in the west. The tank will supplant the metal water coolers which have been in vogue in the Army for many years.

As now in use in the field hospitals, the canvas tanks are suspended from a tripod composed of folded field litters. The tanks are open at the top, and enough physical work takes place due to the porosity of the canvas to keep the water cool even on very hot days. There are five metal faucets at the bottom of the tank from which water may be drawn. The tanks are easily cleaned, while inspection as to cleanliness is readily accomplished. Following the Army custom, the water used in the tanks is chemically treated.

Officers and men who have used the new tanks are enthusiastic over the condition of the water after it has been held in the canvas bags several hours. The canvas tank has the virtue of being easily transported, and, aside from its employment by the Army, it may be used effectively by farmers in the harvest fields, by construction gangs, and in parks where the running water is none too good. It has also the virtue of being comparatively cheap when made in large quantities.

New canvas drinking tank suspended from tripod of folded field litters



Two types of cameras used by German airmen

Recent Vacuum Bottle Developments

A VERY interesting example of practical results obtained through the application of scientific information and research is shown by the steps which have led up to the development of a new type of vacuum bottle designed to overcome the weak points of the glass vacuum bottles previously used.

The invention of the glass vacuum bottle is generally attributed to Prof. Dewar, an Englishman, who produced it for the purposes of a container for liquefied gases; it being necessary to use for this purpose a flask efficiently insulated against heat, as liquefied gases are very rapidly volatilized at ordinary temperatures. Scientists still call these vessels Dewar flasks.

The Dewar flask consists of two glass bottles joined at the top of the neck, but touching each other in no other place, the wall surface of the space between the inner and outer bottles being silvered. This space is then highly exhausted by means of a vacuum pump.

These Dewar flasks were used for many years in laboratory and scientific work for the purposes for which Prof. Dewar designed them, but the device was recognized as being extremely fragile, and no serious effort seems to have been made to adapt it to commercial uses until a German inventor, Prof. Reinhold Burger, strengthened the device by inserting between the two walls little spacers, or supports, and enclosed the whole glass bottle in an outer protecting metal shell. This improved article was then manufactured, and obtained a ready and large market as a conveyor and retainer of hot or cold liquids and foods for household and outing purposes.

A vacuum bottle made of steel

In spite of the improvements just mentioned, however, the article was still comparatively fragile, and, if submitted to jars sufficient to fracture the glass walls, was, of course, rendered inoperative by destruction of the vacuum. The breakage of these bottles led to many attempts to produce similar devices without the use of glass, and, particularly, attempts to manufacture metal bottles having, in general, the same double-walled vacuum space idea originally disclosed by Dewar. Incomplete scientific knowledge rendered these attempts fruitless, because it apparently was not realized that the high vacuum required in the successful Dewar flask is so difficult of attainment in a metal vessel or flask as to be commercially impossible.

A common and popular explanation of the failure of metal vessels constructed along the lines of the Dewar flask was that the metal was porous, permitting the exterior air to leak into the vacuous chamber, thus ruining the vacuum. Convinced that this was not a proper explanation, an American inventor, Mr. William Stanley, while engaged with other scientists—notably Dr. Irving Langmuir—in a study of heat insulation, undertook the task of producing a satisfactory type of heat-insulated, non-breakable metal receptacle.

A study of the action of gaseous molecules as heat carriers in a vacuous space proved, and practical experiments very ingeniously performed by Dr. Langmuir checked up, the theoretical conclusion that the first stages of exhaustion do not increase the heat insulation effect to any practical extent beyond that of a dead air space, but that the commencement of high insulation effect obtained in the Dewar flask is suddenly arrived at coincident with the attainment of a very high vacuum at what might be called a "critical point" in the exhaustion and rapidly increases as this already high vacuum is slightly improved. This "critical point" for Dewar flasks was found to represent a degree of vacuum so high that *on the average* the path of the molecules in a direction across the vacuous space (in scientific terms, the mean free path) was as great as the distance between the outer and inner vacuum walls.

It was a known scientific fact that all metals have buried within them and "condensed" on their surface varying amounts of gases which, in their total amount, are surprisingly large, being many times the actual volume of the metal. These gases cannot be quickly and entirely separated from the metal, but show remarkable tendencies to adhere to and remain buried within the surface. When a high vacuum is produced adjacent to a metal surface, these gases do not leave the metal quickly and rush into the vacuous space, but they free themselves very slowly and for a long time continue to appear in the vacuous space. They therefore cannot be removed by any rapid commercial exhaustion. Glass, on the other hand, while having some gases condensed on its surface, is much more easily freed from them, and the glass-wall receptacle, as contrasted to the metal-wall receptacle, presents a comparatively easy subject for high exhaustion.

Mr. Stanley believed that this phenomenon of occluded gas was responsible for the failure to obtain in metal-walled vessels results obtained in the Dewar flask and that as the occluded gases freed themselves from the metal and appeared in the vacuous space, they increased the pressure (*i.e.*, reduced the vacuum) beyond the "critical point," and so rendered the vessel inoperative. Mr. Stanley then conceived the idea that, if the vacuous walls could be brought so close together that the distance between them would be equivalent to the mean free path of the molecules at a comparatively poor degree of exhaustion, high thermal insulation with a comparatively poor vacuum could be obtained and that, if this comparatively poor vacuum left enough gas in the vacuous space, even the occluded gas of the metal walls when freed might not add a sufficient percentage to the residual gas in the vacuous space to perceptibly alter the vacuous pressure or thermal insulation properties. He accomplished this result not by spacing an inner and outer wall extremely close together, but by filling the vacuous space between the inner and outer wall with a very finely divided material or powder it-

(*Concluded on page 564*)

Photographic Apparatus Employed by German Airmen

THAT the part played by aerial photography is of prime importance in modern warfare has been amply proven during the past seventeen months of the European conflict. Not only do photographs taken from air craft serve to some extent as an index of the strength and disposition of an enemy's forces, artillery and defences, but it is also of extreme importance in the determination of artillery range.

Although details regarding the photographic apparatus employed by Allied airmen have not been made public as yet, those pertaining to two types of cameras used by the Germans are available. The first of these was found on board the Zeppelin No. VIII, which was brought down and captured at Badonvillers, France, on the 22nd of August, 1914, while the second was carried by an Aviatic aeroplane which recently fell within the lines of the Allies.

The camera carried by the Zeppelin consists simply of a metallic case measuring 16 by 16 cm., fitted with a curtain shutter that can be operated at various speeds, according to the intensity of the light and the opening of the lens. A Zeiss-Tessar lens is employed with a useful opening of 4.5 and a focal distance of 30 cm. The lens is fitted with a sun guard in order that clear views may be taken against the light. Double rear doors are provided at the back of the

(*Concluded on page 564*)

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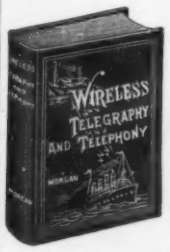


THIS is a comprehensive treatise and a close study of its pages will enable one to master all the details of the wireless transmission of messages. The author has filled a long-felt want and has succeeded in furnishing a lucid, comprehensible explanation in simple language of the theory and practice of wireless telegraphy and telephony.

The book treats the subject from an entirely new standpoint. Several very novel and original ideas have been carried out in its making. It is well illustrated by over one hundred and fifty interesting photographs and drawings. All diagrams have been made in perspective showing the instruments as they actually appear in practice. The drawings are carefully keyed and labeled. Many of the photographs are accompanied by phantom drawings which reveal the name and purpose of each part.

This is a book the wireless experimenter cannot afford to be without. It enables one to design and construct their own apparatus. This book will also prove of value to the layman.

MUNN & CO., Inc., Publishers
233 Broadway New York, N. Y.

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel

CAP.—E. H. DUNN, Address Kaplan, Frank & Dunn, 113 University Place, New York, N. Y. This invention provides a cap with a pocket having a flap and disposed over a visor, it being possible to hold the pocket, and flap down against the visor so that the pocket and flap will be concealed, and the pocket with its contents will be supported by the visor.

GARMENT.—J. B. MOORE, Bayside, L. I., N. Y. The improvement refers particularly to what are known as union suits, and provides automatically effective means which dispense with buttons or other fasteners at the crotch. The invention is highly efficient, considerably more comfortable than garments made in the conventional manner, the flaps being held in overlying positions merely by the weight of the garment from its points of suspension at the shoulders of the wearer.

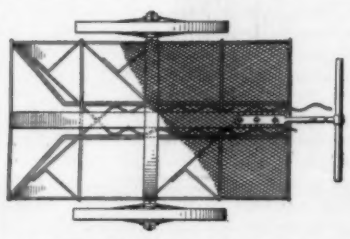
KNOCKDOWN SUITCASE.—A. J. FORWARD, Madison, N. Y. This invention relates to boxes especially adapted for use as suitcases and made of flexible material so arranged that when the suitcase or box is not in active use as a container, it may readily be packed within a small space and so arranged as to be shipped with comparative ease and safety.

Pertaining to Aviation

AEROPLANE.—E. L. RUSSELL, care of the Russell Aeroplane Co., Great Falls, Mont. The invention provides a device in which the elevating or lowering planes may be readily controlled. And, further, it provides a device in which the tendency to tip to the side is obviated by means of a novel arrangement of ailerons.

Of Interest to Farmers

DEVICE FOR KILLING BOLL WEEVILS.—W. D. ROBERTSHAW. Address Watson and Jayne, Greenville, Miss. This invention provides a device which may be drawn along the rows of cotton and which during its movement will knock the insects from the plants without



DEVICE FOR KILLING BOLL WEEVILS.

injuring the latter. It provides a device having pans or receptacles which may be filled with oil into which the boll weevils are projected, thereby insuring the death of the insects and at the same time collecting them.

DRINKING FOUNTAIN.—J. IMSCHWEILER, Inglewood, Cal. The improvement has for its object to provide a fountain especially adapted for the use of poultry, wherein mechanism is provided for retaining the water at a predetermined level within the tank, and for preventing access of animals other than poultry to the water.

STACK CUTTING IMPLEMENT.—W. L. HURST, Aspen, Col. This invention provides an implement for dividing a relatively large stack into relatively small packages; permits the operator to perform the operation while in a standing or upright position; and provides an implement with a series of cutting members designed to accomplish the various uses for which the said implement is employed.

Of General Interest

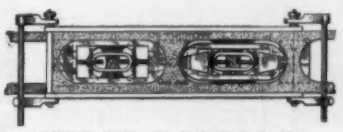
PROCESS FOR THE SIMULTANEOUS PRODUCTION OF SOLUBLE ALKALI HYDROXIDS AND CEMENT MAKING MATERIAL.—A. W. HEYMAN, 2143 Siegfried Ave., Northampton, Pa. The object here is the conversion of the insoluble alkali compounds existing in rocks, earths and minerals, such as feldspar, granite, slate, mica, cement rock (an argillaceous limestone used in making cement), shale, clay, or other substances, into soluble hydroxids of such alkali metals. Mr. Heyman has invented another process relating to the simultaneous production of soluble alkali compounds and cement making material from rocks, earths, and minerals containing insoluble alkali compounds. As examples, feldspar, granite, slate, mica, shale, clay, and other substances in which the alkali exists in an insoluble condition.

HORSE COLLAR.—A. W. DAVIS, 116 Waldbarg St., Savannah, Ga. This improvement has reference to a horse collar having removable pads; and the object thereof is the provision of a simple, inexpensive and comfortable horse collar which is adjustable and in which the detachable pads can be easily and quickly inserted or removed when necessary.

PROCESS OF SEPARATING WATER FROM GAS.—H. BLAU, Augsburg, Germany. An object here is to provide a process for separating water from the gas which can be carried out with the greatest economy, due to the fact that the currents of uncondensed gas, liquefied gas, and water mutually operate upon one another in such a manner that the highest efficiency for artificial cooling is insured.

COMPUTING INSTRUMENT.—YU WANG, Manhattan, New York, N. Y. This invention relates to a computing instrument utilizing various coöperating scales for determining numerical values of algebraic and transcendental functions. It provides an instrument which is efficient, which is relatively flat, and whereby one can read directly from the scales the numerical values of algebraic and transcendental functions.

DEVICE USED IN MOLDING WALLS.—J. S. AMBROSE, Prescott, Ariz. This device is for use in molding a wall with openings which, in each course are staggered relatively to the openings in the adjacent courses so that a transverse tie will be disposed above and below each opening. In constructing the wall use is



DEVICE USED IN MOLDING WALLS.

made of side and end frames which are detachably secured together, the openings being formed by cores, the ends of which are supported by plates which also serve to support the transverse tie sections having disposed as stated over the openings in the course there below.

HOLDER FOR BOOKS AND MAGAZINES.—J. W. CONNELLA, care of Collector of Internal Revenue, Honolulu, Hawaii. The device embodies a rest for the back of the open book, the rest having a handle member at the back for the support of the device. The rest for the book ranges longitudinally of the device, and at the ends, which may be referred to as the top and bottom, transverse clamp elements are provided, provision being made whereby the user of the device may, with the hand that grasps the handle, also operate the clamp controlling means to open or close the clamps, as desired.

CIGARETTE BOX.—A. MENDELSON, 482 Marcy Ave., Brooklyn, New York, N. Y. This invention relates to novel and useful improvements in dispensing boxes divided into compartments for containing cigarettes or similar articles and to permit convenient withdrawal thereof separately without disturbing or injuring the remaining cigarettes or articles.

CIGARETTE BOX OR CASE.—A. MENDELSON, 482 Marcy Ave., Brooklyn, New York, N. Y. This invention relates more particularly to a box or case for holding cigarettes or like commodities, and to so mount them that upon opening the box the cigarettes are caused to assume positions separate and radiating from one another so as to greatly assist in the removal of the cigarettes singly and obviating the necessity of fumbling over them.

CIGARETTE CASE.—A. MENDELSON, 482 Marcy Ave., Brooklyn, New York, N. Y. This invention appertains to cigarette cases or like receptacles for holding elongated objects which, in order to insure their best keeping and permit their convenient withdrawal without resultant injury, must be held independently so as not to come in contact with one another or be permitted to move about when the receptacle is closed, but to move in spaced relation and out of the sections forming the receptacle or case when the latter is open.

BINDING AND HANDLE ATTACHING TAPE FOR PACKAGES.—A. MENDELSON and S. J. GOLDBERG. Address the former 482 Marcy Ave., Brooklyn, New York, N. Y. The main object here is to eliminate the use of cord or other package fastening devices necessitating knotting of the cord or provision of expensive metallic parts for anchoring the ends of the cord or tying material and also to avoid the objection to ordinary adhesive strip paper commonly used for fastening a wrapper on a package.

Hardware and Tools

DOUBLE PRESSURE SET SCREW.—A. MENDELSON, 482 Marcy Ave., Brooklyn, New York, N. Y. The purpose here is the provision of a screw embodying a shank and a point so connected as to cause a double application of pressure against an object to be held by turning the shank after the point is so engaged with an object as to prevent its rotation, thereby reducing the amount of pressure required to tighten the set screw.

DENTAL HANDPIECE.—W. WOOD, JR., 1817 Carrollton Ave., New Orleans, La. This invention provides a handpiece improved with respect to simplicity, and embodying in its make-up a materially reduced number of parts as compared with those usually employed, and the specific nature of which parts permits of their economical manufacture.

COOKING UTENSIL.—EMMA R. MEYER, 51 W. 145th St., New York, N. Y. This utensil has a close fitting lid held in position so that when in one position the steam will be practically held within the utensil and in another position openings are provided through which the water or juices may be drained off, the lid supporting and retaining means insuring that the operator cannot be scalded or burned, and the device may be manipulated for the purpose of draining off the water by the use of one hand only.

VARIABLE SPEED DRILL.—F. H. HEDINGER. Address Joseph Rosenfeld, South Ferry Bldg., New York, N. Y. This invention has particular reference to tools or implements such as breast drills or the like adapted for hand or power operation at variable speeds. It permits quickly manipulated means for changing the gearing through which the speed of the boring or drilling tool may be changed.

PAPER CLIP.—W. P. J. MURRAY, Harrison Bldg., Philadelphia, Pa. The invention provides a clip having a central body portion arranged to lie on one side of the paper

PAPER CLIP.

and having wings adapted to lie on the opposite side, each of said wings being so formed as to provide a socket for receiving the end of the thumb or fingers thereby preventing the latter from slipping off of the clip when the clip is being attached. It is especially adapted to be placed at the rectangular corners of envelopes, cards or other similar devices.

Heating and Lighting

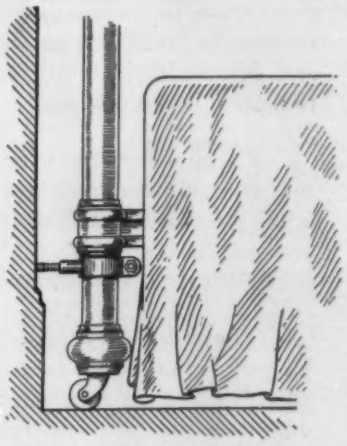
FLUE CLEANER.—A. C. SCHMELZER. Address Schmelzer & Arthur Mfg. Co., Springfield, Mass. The improvement relates to means for cleaning steam boilers, and one of the main objects thereof is to provide a device whereby a plurality of jets of steam may be directed into said flues from a tubular arm adapted to be swung in front of the open ends of said flues.

HOT AIR RADIATOR.—D. REYAM, 2008 Van Buren St., Wilmington, Del., and M. Mayer, Freeport, N. Y. This invention relates more particularly to a hot air radiator designed to be used in connection with hot air heating systems having a wall pipe for conveying heat from the heating drum of a stove or furnace to the various rooms of a house or building.

Household Utilities

CLOTHES LINE SUPPORT.—C. F. SMITH, 184 Park Place, Brooklyn, N. Y., N. Y. The improvement refers particularly to a support adapted to be arranged on a window frame and to be swung in and out through the window opening, and an object is the provision of a construction readily applied and readily removed which may be utilized for supporting a single line or plurality of lines.

FURNITURE BUMPER.—W. H. HEINES, care of Street and Smith, 79 Seventh Ave., New York, N. Y. Among the principal objects which the present invention has in view are: to prevent articles of furniture from marring the



FURNITURE BUMPER.

side walls of a building; to provide detachable fixtures of the character mentioned of simplified construction and reduced cost, and to provide means for adjusting the operating condition of bumpers of the character mentioned.

COMBINED MOP HEAD AND WRINGER.—E. C. WORNS, 287 W. 127th St., New York, N. Y. The present invention provides a novel form and arrangement of the sector relative to the co-acting gear element of the twisting loop, whereby the intermeshing gear teeth will be held to their work and will resist the tendency to separate under the severe strain exerted thereon by the twisting of the mop cloth.

PAN LIFTER.—P. H. WILSON, Talent, Ore. The invention relates to the transportation of cooking, baking, and other utensils from place to place, especially in the event of said utensils being too hot or dirty to be manually handled, and the main object thereof is to provide a device which is adapted for instant engagement and disengagement with utensils of various kinds and classes, whereby the same may be moved from place to place.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Industrial Preparedness for Peace

Cut off from the products of the old world, the United States has awakened to a realization of its extreme youth and dependence upon the parent countries across the water.

With the prodigality of youth, we have been most lavish in the use of our resources and neglectful of their development. The natural products of this country have gone abroad to be worked into finished articles and be re-transported to this country. Even our waste materials are taken over by European manufacturers and returned to us in useful form. We must learn to do for ourselves what others have been doing for us.

Our younger brothers on the Western hemisphere find themselves in an even more helpless condition of dependence, and the opportunity to develop a vast export trade awaits us.

We have prided ourselves on our *political independence*. It is time we worked out our *industrial independence* and carried into foreign fields the products of our manufacture.

New lines of work, which the necessity of war imposes upon us now, will meet with keen competition as soon as the European nations return from fields of battle and resume their industrial operations. How are we to meet this competition?

The time for us to prepare for the industrial struggle that will follow the declaration of peace is *now*. Otherwise, we shall lapse into our old helpless dependence, and may never realize the destiny of becoming a really great industrial nation.

The SCIENTIFIC AMERICAN is launching a campaign of *industrial preparedness for peace*. We are planning to publish helpful articles on our opportunities and how they may be realized, on our wonderful resources and how they may be developed, on our manufactures and how they may be improved, how we may eliminate waste of material and waste of effort.

This is the day of coöperation. The day of secret processes is past. There is no more inefficient work than that of the burglar. He must learn his trade in secret, and the chances are that he will be caught before he proceeds very far. His is an extreme illustration of solitary effort. No man can develop his work to a high degree of efficiency without studying the methods of others.

The Industrial Editor of the SCIENTIFIC AMERICAN invites manufacturers to send him such suggestions as have been helpful to them and to contribute their ideas on this patriotic movement of *industrial preparedness for peace*.

A Newly Discovered Story of the Garden of Eden

(*Concluded from page 558*)

Gulf. To just what race they belonged, or where they originally lived, no man knows. We are only sure that at a very early time, probably about 4500 B.C., they came to Babylonia bringing a high civilization with them. They wrote their language in cuneiform characters upon tablets of clay and stone. They had a highly developed religion, literature and art. Poems and legends and historical inscriptions have come from them. They were the world's cultured people of 6,000 years ago, just as were the Greeks of a later period. After the Sumerians had occupied Babylonia for several centuries, the Semitic Babylonians, from whom the Jews descended, entered the valley. They conquered the older civilized Sumerians, possessed their cities, and adopted their culture. The Semites had no written language, but soon they began to write their spoken language in the Sumerian characters. They adopted many of the Sumerian religious customs, and made that earlier civilization their own. It was these cultured Sumerians who wrote the story upon the tablet in the University of Pennsylvania.

A brief outline of the story is as follows:

Enki, the god of the sea, and his wife or daughter Ninella, ruled over Mankind in Paradise. Paradise was the land of Dilmun, or the modern island of Bahrein. In Paradise sickness was unknown. Sin had not entered. Though the years passed, it was a land of perpetual youth. No wild beasts destroyed the flocks, and no storms raged. Enki, the god, decided to destroy mankind with a flood, and he revealed his purpose to Nintud, the goddess who had created mankind. For nine months and nine days the flood raged, and men were dissolved in the water "like tallow and fat." But Nintud, the mother-goddess, determined to save the king, Tagtug, and him she called to the shore and embarked on a boat. Tagtug, who was thus saved, corresponds to the biblical Noah. It was the custom of the Babylonians to deify their kings after death. The goddess Nintud explained to the god Enki how Tagtug had escaped the universal destruction, and had become a god. He then became a gardener. Enki revealed to him the secrets of trees and plants. Tagtug was permitted to eat of the fruit of all the trees, excepting that of the Cassia. But he ate of the fruit of the Cassia tree, and at once the goddess Nintud took from him immortality. He was compelled to labor and suffer until the gods took pity on him and taught him various arts to comfort him.

Photographic Apparatus Employed by German Airmen

(*Concluded from page 562*)

camera for the insertion of plates. The field of vision of the apparatus is determined by a direct-view finder. Incorporated in the camera is an arrangement which permits of the placing of a screen filter between the plate and the lens when orthochromatic emulsions are used on the negative plates.

This form of photographic apparatus has no absolutely novel features. Because of the great heights at which the Zeppelins are compelled to fly during daylight in order to avoid hostile artillery fire, it is not believed that a camera of this kind is often employed.

Of far greater interest is the photographic apparatus that was found on the Aviatic aeroplane and which presents a number of innovations. It appears to be the model used on all heavier-than-air German aircraft, and its dimensions are 9 by 12 cm. The body is of metal, covered with a waterproof fabric. The Zeiss-Tessar lens with which the camera is provided has a focal length of 25 cm. and a useful opening of 3.5. Inside the camera, between the lens and the negative plate, are alternately placed a yellow compensating screen for the use of orthochromatic plates, or, if plates with ordinary emulsion are used, a similar incolorous screen which, under the identical conditions, rectifies the modification of the focal distance resulting from interposing screens. Both the screens are manipulated by a lever placed outside. The finder consists of two members: The first, placed at the front, a slide arrangement with a center mark, while the rear member is a smaller folding frame with a sighting groove. The shutter is of the focal plane type, with the speed and opening adjustable on the outside. Exposures may be made with the shutter of from 1-50 to 1-800 second; a lever and dial fitted on the apparatus permitting the selection of any speed desired. Six sensitive plates are carried in an interchangeable holder. The shutter is operated by a trigger, similar to that employed on firearms—in fact, the entire camera has the appearance of a revolver. It is held by a form of revolver handle to facilitate pointing in any direction, and another handle is provided farther front should the rear one not be as satisfactory for certain positions. By a very clever arrangement the trigger operates two halves of a curtain which opens at the snapping of the shutter and closes the moment the exposure is finished, thus permitting the recocking of the shutter whose movement would otherwise expose the plate which the holder has just put into position for the next exposure.

Recent Vacuum Bottle Developments

(*Concluded from page 562*)

self, so chosen or prepared as to be incapable of giving off gas in a vacuum or even to be absorptive of gas in a vacuum. By this procedure each air space enclosed between the granules of the finely divided powder became to all intents and purposes a separate vacuous space of which the granules were the vacuum walls, so that the distance between these granular walls was extremely minute. Vessels constructed on this principle fully confirmed Mr. Stanley's conclusions. Subsequently, he evolved a commercially practical vacuum bottle without the use of glass.

Having perfected his invention, Mr. Stanley turned his attention to the various methods of joining metal which were in general use, and found none that was entirely satisfactory as combining air tightness with extreme strength. After considerable experimenting he has developed an improved method of electric welding which makes a joint not only vacuum tight, but stronger than the sheet metal itself. By using this method he has developed a metal bottle which, although built up from a number of parts, is one solid metal unit when completed. This construction eliminates any danger of breakage at the joints and is the finishing touch necessary to render possible his vision of a highly efficient steel-walled vacuum bottle.

The Freight Congestion at the Port of New York

(*Concluded from page 555*)

were held at points west of Philadelphia. At this time there were six ships at the port of Philadelphia loading grain, six waiting to load, and four others were expected. Likewise in the Baltimore elevator of the same railroad there were 2,000,000 bushels of grain in storage, and 2,629 cars, with 4,240,000 bushels of export grain on hand, destined to go through that elevator. Of this number 940 were at Baltimore, while the remainder were held at various points on the Baltimore and other divisions.

On December 15th the railways declared further embargoes chiefly affecting export shipment, but dealing also with freight requiring lighterage in New York Harbor. At this time it was reported that there had been an increase of approximately 3,500 cars consigned to New York over the total of the previous week. Working at full capacity the lighterage facilities and the floating equipment of the railways cannot deliver daily more than 1,500 cars and this number is materially reduced with storms or other unfavorable conditions.

One of the picturesque items of the congestion on account of their bulky nature

has been the export of automobiles which were leaving the United States at the rate of considerably over $100,000,000 per year in value. From the port of New York alone for the week ending December 4th, nearly $3,000,000 worth of automobiles and parts were exported, and of these, commercial automobiles alone amounted in value to $500,000, going chiefly to Russia, England and France, while more than $500,000 worth of passenger cars were distributed throughout South America, Asia, Australasia, and Africa, and the continent of Europe. Tires alone amounted to $500,000 in value, going mostly to England, while other parts of automobiles amounted to more than $250,000 and went to Russia, France and Spain.

Aside from motor trucks and other vehicles, locomotives, freight cars and other railway supplies, especially for Russia, have been an important feature as exports from the United States. These also are of a bulky nature and require considerable cargo space for stowage. They have, however, figured very largely, and some of the most essential railways in Russia are being equipped with American rolling stock and other material.

The exports from the United States during the week ended December 11th, 1915, amounted to over $98,057,700, which is the highest figure for a single week ever reached by exports in the United States, an excess of exports over imports of $60,350,300. Of these exports, $70,371,524 went from the port of New York, where naturally the congestion has been the most intense. In a typical week, that ended December 4th, the exports included over $10,000,000 of explosives, approximately $2,000,000 of empty shells, and $3,000,000 of other materials for war purposes, or an average of about $3,000,000 a day. Of the $10,000,000 of explosives, smokeless powder amounted to $3,457,535, which was about equally divided between France and England. $2,500,000 was loaded projectiles, all for England, nearly $500,000 gun powder, divided between England and Italy, $250,000 trinitrotoluol, divided between England, France and Italy, $750,000 worth of gun cotton, chiefly for France, and approximately $500,000 of cordite, and $500,000 cartridges, sent chiefly to England.

England also took the greater part of the $2,500,000 empty shells, while the $500,000 firearms practically all went to Russia. Other war equipment included $500,000 barbed wire for Russia, and $500,000 aëroplanes chiefly for England.

Progress of the Seagoing Flying Boat

(*Concluded from page 555*)

ments, one third of which are supposed to keep the machine floating, should the hull be pierced and several compartments be flooded.

The inner arrangement of the boat consists (1) of a conning tower containing the controls and the navigating instruments, and (2) of a cabin, fitted as quarters for a crew of eight, and containing the fuel tanks, ammunition and stores.

The boat is steered from the conning tower; when riding a rough sea the latter can be hermetically closed against the spray. The fuel tanks contain 700 gallons of gasoline and 80 gallons of oil; this will give the machine (at a speed of 75 miles per hour) a cruising radius of 675 miles. This could be considerably increased by fitting additional tanks, in which case the military load (guns, bombs, etc.) would have to be decreased. The superstructure of this battleship-aeroplane consists of (1) the supporting planes; (2) the propelling apparatus, and (3) the steering organs.

There are three superposed supporting planes, each having a span of 133 feet and a chord of 10 feet, with a gap of 10 feet between each plane; the total area of support amounting to about 4,000 square feet. The weight of the hull and of the supporting planes amounts to about 12,000 lbs. As customary on marine aeroplanes, the tip of each lower wing is fitted with a pontoon, which prevents the wing from digging into the water when running on the surface or when at anchor.

Just like the "America," which revolutionized aircraft construction with her twin engines, the latest product of the Curtiss yards marks again a new departure in the arrangement of the propelling apparatus. The latter consists of six 160 h.p. water-cooled V-type engines, which are coupled in twin units of 320 h.p., each unit driving an air-screw about 15 feet long. But while one of these twin units is placed amidship and drives a central pusher screw, the two other units are mounted on the leading edge of the center plane on either side and above the cabin, and each drives a tractor air-screw.

An auxiliary engine of 40 h.p. enables the pilot to start these engines from the conning tower by means of an electric starter. This engine is also used for generating the current required by the automatic stabilizer, the drift indicator and the minor apparatus. Finally, for water navigation, the auxiliary engine also drives a water propeller.

Aside from the truly gigantic dimensions of this machine, the disposition of her power plant marks a notable advance in aircraft construction.

If in an ordinary aeroplane the engine fails, the airman has to glide down to earth in order to effect repairs. In the twin-screw flying boats of the "America" class this contingency arises just as well, but as long as one engine is kept running, skillful steering will keep the machine on a much longer glide-path, whereby there is much less risk for the pilot to fall into the hands of the enemy.

But in the new triple-screw flying boat, engine trouble can be dismissed almost entirely as far as the machine's safety is concerned. In fact, each of the three air-screws being actuated by twin engines, the failure of one or two of the engines will only result in reducing the flying speed; and, owing to the great inertia of the machine, a mechanic can easily climb on a ladder to the defaulting engine and promptly repair it without impairing the lateral stability. And, taking it at its worst, should both of the twin engines, which drive the tractor-screws, break down, the engine unit actuating the pusher-screw (320 h.p.) would still give the boat a very wide gliding ratio, about 15 in 1, in the course of which there still would be time to repair the defaulting engines or else to choose the best possible landing place.

This feature of the new flying boat makes her particularly desirable for military and naval work, where long range reconnaissances are always fraught with danger on account of the relative unreliability of flight engines.

The steering organs placed at the boat's stern consist of a balanced rudder of 54 sq. ft. area, with a keel-fin of 46 sq. ft. area. Longitudinal stability is effected by a non-lifting tail, consisting of a tail-fin of 126 sq. ft. area and of an elevator of 96 sq. ft. area. For transverse stability, interconnected ailerons are hinged to the supporting planes.

Little is known so far as to the armament this flying boat will carry. Whereas the pure military load (outside of crew, instruments and fuel) amounts to about 3,000 lbs., it can be safely assumed that at least two 1½-lb. aircraft guns, of the type used on the "America" class, will be mounted on the forecastle, in addition to which there should be a small battery of machine guns for repelling speed scouts. It is possible, however, that the main armament will comprise a much heavier arm, such as a 3- or even a 6-pound gun, and that there will be a trap-door in the hull through which the said gun could be fired in all directions, owing to a turret mounting.

The craft will carry a very complete equipment, such as pneumatic life preservers and cushions, fire extinguishers, anchors, ropes, and possibly a collapsible mast for signaling.

Altogether, there is no exaggeration in saying that the Curtiss triple-screw flying boat opens a new epoch in aircraft construction; and while far from being an aerial battleship such as may be seen in the future, she certainly represents the embryo of such an idea. In the present war she should prove immensely valuable; for in view of her superior armament, cruising radius and sufficient speed, there does not seem to be anything aloft that could meet her on even terms.

Some of the World's Largest and Most Notable Bridges

(*Concluded from page 559*)

cases being stone or concrete. Arched masonry road bridges were built freely throughout the Roman Empire, and many of them are standing and in use to-day, both on the Continent and in the British Isles. The arch, when properly designed, is an inherently beautiful structure, and as such, has always commended itself to the eye. We direct attention to the truly beautiful marble arch bridge near Pekin, China, of which we present an illustration.

Because of the weight, there is a constructive limit to the span of masonry bridges, and, thus far, about 300 feet seems to be the maximum length to which they can be built; although designs were drawn in the New York Bridge Department for a reinforced-concrete arch over the Harlem River at Spuyten Duyvil, New York, whose span was over double that length.

The advent of steel, with its higher strength in proportion to its weight, enabled the engineer to build arch bridges of a hitherto undreamed-of span. During the past three decades, some notable and very handsome steel arch bridges have been constructed in which the span has been carried up, first, to 500 feet and over and finally to 1,000 feet. Among spans of approximately 500 feet may be mentioned the Washington Bridge, over the Harlem River—the Eads St. Louis Bridge, over the Mississippi—the double-deck bridge over the Douro River at Oporto, Portugal—the bridge over the Zambezi, South Africa, which, by the way, is highest above the chasm which it crosses of any existing bridge.

The next advance was seen in the construction of the steel-arch bridge, which replaced the old wire suspension bridge across the Niagara River below the Falls, which has a span of 840 feet. This has provision for vehicles, trolley cars and foot passengers.

The greatest arch bridge in existence is the massive four-track railway bridge designed by Gustav Lindenthal which crosses the East River at Hell Gate and forms a part of the connecting railway which unites the New Haven and Pennsylvania railroad systems at New York. It consists of two parallel arched trusses, from which is suspended a solid roadway upon which will be laid the stone ballast and ties of the standard Pennsylvania railroad track construction.

An interesting type of bridge, which has had a considerable vogue in Europe, is the bowstring truss. One variation of this type is shown in our illustration of the handsome structure which crosses the River Elbe at Hamburg. Each span consists of two double-arched trusses, the lower of which is inverted.

One of the most economical and serviceable types of bridge is the suspension, and probably, in its crudest form, it is one of the most ancient. We present an illustration of a primitive construction of this kind which forms the means of crossing the Jheelum River in India. It consists of three stout ropes of native manufacture, the bottom one forming a footrope and the other two the handrope, the three being held in a position by a series of wooden forks, which are lashed securely to the ropes and serve to hold them in their proper relative position.

It was not until the coming of the age of modern iron and steel manufacture that it was possible to develop the inherent possibilities of the suspension system for bridges of long span. In the earliest of these bridges the suspension member consisted of flat bars or links, which were pinned together to form chain cables. Some notable bridges of this type were built in England, one of the earliest of which is the famous old chain bridge across the Menai Straits, designed and built by Thomas Telford in 1820 to carry the post road from the main land to the Isle of Anglesea. On the same

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road was built at Conway another bridge of this type, and the architect had the good taste to design the towers and abutments to conform to the architectural features of the nearby Conway castle, as shown in one of our illustrations. Another interesting chain suspension bridge is that over the River Avon at Clifton, Bristol, England. The chains for this bridge formerly formed part of a bridge across the Thames at London.

The introduction of iron, and latterly of steel wire with its high tensile strength, rendered it possible to build suspension bridges of hitherto unpresented length. The great Roebling, over 30 years ago, conceived the bold idea of crossing the East River with a wire suspension bridge and he translated his dream into a splendid reality by successfully erecting the present Brooklyn Suspension Bridge, which, after over 30 years of service, is carrying loads far in excess of those contemplated by its designer. The clear span between towers is 1,959 feet. Subsequently there have been built across the East River the Williamsburg Bridge of 1,600 span and the Manhattan Bridge of 1,470 feet span.

The triangulated truss bridge, self-contained and carried on end supports, is the type which more than any other has been used in solving the problem of crossing broad rivers and wide chasms, both for highway and railroad construction. In present practice the plate girder bridge is used in spans up to about 175 feet, the truss bridge from 175 to 700 feet, the cantilever from 700 to 1,800 feet, which is the span of the great Quebec Bridge, and the suspension bridge is found to be the most economical for spans of from 1,500 to 2,000 feet or over. Lindenthal has designed a bridge across the North River with a span of 3,200 feet, which should the necessary capital be found, will undoubtedly be built.

Perhaps the most notable bridge, to-day, is the great cantilever structure over the Firth of Forth, Scotland, designed by the late Sir Benjamin Baker. It has two clear spans of 710 feet and it is so strong and stiff that a heavy express train service is run across it, daily, at speeds of 60 and 70 miles an hour.

United States Patents Issued For Week Ending December 28th, 1915

ACCORDING to a tabulated statement appearing in the Patent Office *Gazette* for December 28th, 1915, the following patents, trademarks, labels, prints and reissues were granted for the week covered by that issue:

Patents, No. 1,165,375 to No. 1,166,418, inclusive	1,044
Designs, No. 48,342 to No. 48,357, inclusive	16
Trade-Marks, No. 107,729 to No. 107,874, inclusive	146
Labels	—
Prints	—
Reissues, No. 14,037 to No. 14,039, inclusive	3
Total	1,209

NEW BOOKS, ETC.

AUTOMOBILE TROUBLES AND HOW TO REMEDY THEM. By Charles P. Root. Chicago: The Charles C. Thompson Company, 1916. 8vo.; 256 pp.; illustrated. Price, $1.

This revised edition of a favorably known handbook by the former editor of *Motor Age* appeals alike to owner, operator, dealer, and salesman. It includes a useful trouble chart, and all explanations and suggestions are phrased in such lucid language that the veriest tyro will find no difficulty in following them.

MODERN ELECTRICITY. A Practical Working Encyclopedia. By James Henry, M.E., and Karel J. Hora, M.Sc. Chicago: Laird & Lee, Inc., 1915. 12mo.; 355 pp.; 150 illustrations. Price, $1.

This handy little manual concisely explains the theories and principles of electricity, and the most common instruments and machinery of its practical manifestations. It treats briefly of the power station and the railway, telegraphy, telephony, electric light, and electroplating. There is also some material on X-rays and radium, and a number of useful estimates and calculations are offered. Two special wiring diagrams are given, with careful explanations. An exhaustive cross-index furnishes the consulter with ready access to any desired information.

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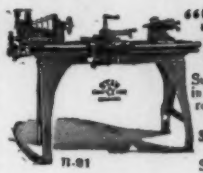

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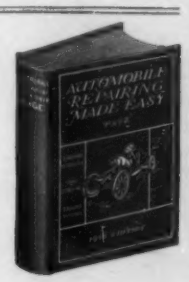

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